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A CLINICAL CONSIDERATION OF INTESTINAL OBSTRUCTION*

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THE salvation of human life," says Lord Moynihan of Leeds, "is a greater thing than the establishment of a convincing, irrefutable clinical diagnosis," and Arthur Curtis remarks, in another connection, that "it is better to have a less accurate diagnosis and a more favorable prognosis." There are possibilities of danger in these aphorisms, I admit, but if they were steadfastly borne in mind we should see a prompt reduction in the mortality of at least one clinical entity. I have reference to intestinal obstruction, a condition in which the lowest mortality is achieved not by the conservative surgeons who operate only on definite diagnoses and for whom, ordinarily, we have only praise, but by that other group of surgical enthusiasts whose resort to the knife is immediate and for whom, ordinarily and properly, we have only condemnation. Their craftsmanship may be dubious, their surgical judgment is unquestionably dubious, but in this one contingency, at least, we would do well to emulate them, for they lose the fewest patients from this deadly disease.

For surgery is the one treatment, the only treatment, for intestinal obstruction. Exploration is warranted on the barest suspicion that it exists. A properly made exploratory incision seldom does harm, and surely it is a better thing to open the abdomen and find nothing than to open it after days of delay, when a moribund patient carries his diagnosis on his face, and find pathology which, because priceless time has been lost, no amount of surgical judgment and no exhibition of surgical dexterity can possibly remedy.

The logic of immediate operation is apparent if we reflect upon the true nature of intestinal obstruction. Its pathology is purely mechanical in origin, and mechanical faults can be rectified only by mechanical means. The spontaneous formation of a fecal fistula or the spontaneous correction of the obstruction are possibilities too remote to be seriously considered. The patient who is not operated on is going to die. He may die anyway, he will certainly die if surgery is delayed too long, but that is no reflection upon surgery. It is, however, a decided reflection upon the quality of the surgical judgment that deferred its performance.

You know the incidents of the sorry story so well that I need not linger upon them. The patient, seized with abdominal pain, resorts to purgation, the great cure-all of the laity. When he grows no better he calls in the medical man, who experiments with further purgation, with opiates, with fine-spun laboratory tests and other time-consuming measures. Eventually the surgeon is summoned, the surgeon who is quite as prone to delay as is his medical confrère but who escapes a good deal of opprobrium because in most instances

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he is not in at the start. Finally operation is resorted to, and operation, late in this disease, is most often the gesture of despair. It is done, as Lincoln Davis vividly says, not with any special hope of saving the patient but simply because the ethics of the profession does not permit one to operate for "a batting average." Even in the early stages of intestinal obstruction the patient is much sicker than he looks, and in the late stages he is plainly so ill that no medical knowledge is necessary to assert that here is a human being beyond the hope of succor.

At this point I am minded to refer, although with considerable trepidation, to a tendency widely current in this age of research, the tendency to lose sight of the clinical aspects of this condition, as of many others, under the weight of laboratory details. I hope that you will not misunderstand me. I have only the highest praise for the work that has been done by such investigators as Whipple, Stone, Scholefield, Hermann, Gatch, Trusler, Ayres, Foster, Haden and Orr. It has been of incalculable aid in determining pathology and in establishing a therapeutic rationale, and almost without exception the men who have done it have preached and taught that nothing which they have discovered, nothing which they hope to discover, can obviate the necessity for speedy operation in every instance of intestinal obstruction. But, consciously or unconsciously, much of their work has been distorted and made to seem a justification for procrastination. Certain of the profession, at least, have tended to dwell on the experimental work done on laboratory animals, on the exact nature of the toxins elaborated in the bowel, on the precise causes of death, forgetting that in the final analysis the only important aspect of this disease is its clinical aspect. Our chief concern must ever be with the damaged bowel wall. A knowledge of the lethal agents present may be important, but surely it is more important to dwell upon the early clinical manifestations, the prompt recognition of which will remove any necessity for studying their terminal results. Moreover, conditions produced experimentally in animals by no means parallel conditions actually present in humans, and it might be well, at least occasionally, to pay less attention to mice and more attention to men. Finally, in this disease preeminently, the pathology of the living is a study of considerably more value than the pathology of the dead, and a deeper concentration on it would undoubtedly mean that the autopsy room would furnish us with fewer examples of it.

The protean character of intestinal obstruction is very often overlooked. It is anything but a simple disease. It is true that in the beginning, unless there is immediate circulatory damage, the picture is one of a simple blockage of the fecal current by some mechanical obstruction. But once the pathology has lasted an appreciable time, even those cases which have begun as simple obstructions merge promptly into the vascular type. Then, with interference to the circulation, come damage to the bowel wall, gangrene, necrosis, even perforation with consequent peritonitis, and the elaboration of a toxemia which is perhaps the most serious feature of all. In short, intestinal obstruction is a disease which remains localized only a very little while, and in which constitutional changes of the gravest sort come to pass within an amazingly short space of time.

It follows, then, that in a disease of such potential gravity the promptest diagnosis and treatment are essential. But this is not as simple as it sounds. The symptoms and physical signs are inconstant and variable, and diagnostic methods are far from conclusive. In practically no early case is the full classic syndrome apparent, and, as a matter of fact, when it does appear the patient is very likely to be near his death agony. The surgeon who operates for obstruction only when the diagnosis is confirmed by

the full complement of symptoms may achieve an enviable reputation for diagnostic acumen, but it will be in the autopsy room, for he will have few living patients to his credit.

Pain, the earliest symptom and the most constant, is, I would say, the inevitable concomitant of intestinal obstruction. I would remind you, however, that the abdominal viscera are largely insensitive, even when they have become pathologic, and that a proper comprehension of the mechanism by which pain is produced is even more essential in this case than it is in most other abdominal diseases. Only in rare instances is exact localization possible. The pain most usually originates vaguely about the umbilicus, less often in the epigastrium, but finally the whole abdomen is implicated. The character is quite definite. If the mesentery is involved the pain is continuous from the outset. Otherwise it begins in a colicky and intermittent fashion, and it becomes continuous only when the disease has progressed beyond the first stages. Be not deceived, either, by its subsidence. That in itself may be a most misleading thing, for it may portend the development of gangrene and not the abeyance of pathology.

Vomiting is by no means the constant symptom which pain is. In obstruction of the small bowel it is present from the start, at first as a reflex phenomenon, later because of a hypersecretory activity of this normally very active portion of the intestine, an activity which may be increased, aside from the obstruction, by misguided efforts to force fluids by mouth. In colonic obstruction, on the other hand, vomiting is usually a late symptom and it may never appear. At first the vomitus consists of gastric contents, then of bile-stained fluid, and finally of true fecal matter, unless this latter development is prevented by the fact that the small bowel obstruction acts upward as well as downward. There is no more misleading symptom than this same fecal vomiting, and I am in hearty accord with the writers who contend that the term should be removed from the vocabulary of intestinal obstruction. It is absolutely diagnostic of obstruction, but it is likewise absolutely prognostic of impending death, and for my own part, I have never seen a patient recover in whom true fecal vomiting had been exhibited.

Since the very term intestinal obstruction carries with it the implication of a stoppage of the fecal current, it might be expected that absolute constipation would be a definite and immediate symptom. This is far from the truth. The higher the obstruction, the less likely is constipation to be evident promptly, and it must be remembered, too, that in intussusception and mesenteric thrombosis, frequent thin, watery, blood-stained stools are more likely to be the rule. It is often urged, in this connection, that, as a diagnostic measure, two enemata be given, the first to empty the bowel, the second to demonstrate the obstruction. Aside from the fact that this is a time-consuming procedure, it may not serve the purpose at all, for in a high obstruction even mechanical means may not fully or promptly empty an overloaded lower bowel. Moreover, unless there is complete relief of symptoms simultaneously, the mere passage of feces cannot be accepted at its face value. More to the point is the suggestion of Codman, that digital rectal examination be done routinely, which will reveal an empty rectum in which the walls crowd around the finger, while above is a sensation of tremendous intra-abdominal pressure. Quinn emphasizes the same point, declaring that it is more important to insert a finger in the lower end of the alimentary tract than a thermometer in the upper.

Distention is the promptest and most conspicuous physical sign, but again it is an inconstant manifestation and a late one, except in volvulus of the sigmoid, when it may be prompt and alarming. Tenderness is never apparent until after distention

has occurred. Rigidity is evident only when localized peritonitis has set in, and in marked toxemia, when the muscular defense is lacking, it may not appear at all.

Visible peristalsis is pathognomonic, but it can be demonstrated only occasionally and late. Audible peristalsis, however, is a different matter, and many agree with Deaver that auscultation of the abdomen, either with the naked ear or with the stethoscope, should never be omitted. In the early stages, as he points out, there is a hyperactive, noisy, whirring peristalsis, which ceases absolutely at the point of obstruction. In the second stage there is a high-pitched, bell-like tinkle, due to gas and fluid moving in a tubular space. And in the final stage there is the "ominously silent" abdomen, in which all activity has ceased and in which the only sound is the pulsation of the aorta. Bayley of Los Angeles describes another sign which I have nowhere else seen mentioned. He claims that in certain early cases, as the result of free fluid under tension, the heart sounds may be transmitted through the abdomen and heard in any or all of its four quadrants. Unfortunately, while this sign is almost pathognomonic, it is inconstant and is therefore of value only in conjunction with other findings.

Elevations of temperature, as would be expected in a condition that is not primarily inflammatory, are never apparent in the early stages of intestinal obstruction, at which time normal or distinctly subnormal temperatures are the rule. The pulse, on the other hand, tends to rise speedily, and this fact, taken in conjunction with the low temperature, is an important diagnostic point. Shock is apparent from the first when the circulation is affected, is always associated with distention, no matter what the primary cause of the obstruction, and is always a part of the toxemic picture of the final stages. The blood pressure of these patients, therefore, must be carefully watched from the outset.

A routine urinalysis is, of course, imperative, but otherwise the laboratory offers smal aid, except of a negative kind, in the early case. The blood count, unless the circulation is affected, remains within normal limits until inflammatory changes have set in. Continued vomiting eventually produces definite body changes, the most marked of which is a disturbance of the blood electrolytes, depending largely upon the location of the obstruction. Blood studies will often show a loss of chlorides, a rise in the non-protein blood nitrogen, and a rise, sometimes to extraordinary figures, of the CO_2 combining power of the plasma. These changes, however, occur too late to be of diagnostic value, and there is small ground for the suggestion, occasionally advanced, that the indications for operation in intestinal obstruction should be based upon repeated tests of this character. Renal damage is evident late, not only in the laboratory findings, but in the lessened fluid output, sometimes amounting to actual anuria. Indeed, in the absence of an adequate history, a patient in the last stages of intestinal obstruction could, from the clinical picture, quite logically be treated for uremia, and I have more than once seen this happen, the true lesion being discovered only at necropsy.

Although I am strongly opposed to the administration of a barium meal in any suspected intra-abdominal pathology, I am heartily in favor of the use of the *x*-ray as advocated by Case of Chicago. The patient is examined, preferably in the standing position, and the relative levels of gas and fluid are studied as soon as the plate can be developed. This procedure takes but a short time, and in the hand of a skilled roentgenologist it can be very valuable in the elucidation of obscure cases.

The diagnosis of intestinal obstruction, it is clear, must be made with a very confusing array of symptoms and signs, and with very uncertain methods of diagnosis. Yet it must be made promptly, for, as we have said, this is one disease in

which literally moments count, in which the development of the classic syndrome is an almost certain sign that the patient has passed beyond mortal aid. What should be our procedure in this grave hour? First, there must be a careful history, with special reference to past surgery and similar past attacks. Intestinal obstruction is very often a bolt from the blue, but it may have definite antecedents, the chief of which is a story of previous surgery especially for pelvic disease or for appendicitis with drainage, for these two types of operation are estimated to furnish from 20 to 40 per cent of all intestinal obstructions. The history of the present attack, with the character and chronology of the symptoms, is equally important. Then must come a physical examination sufficiently general to eliminate intercurrent disease, sufficiently detailed to investigate all areas of the abdomen, all hernial openings, all rectal pathology, and, in a woman, all pelvic pathology. A urinalysis and a blood count should be routine, and blood may be taken for chemical study, though, as I have said, there is no justification for delaying operation until this type of investigation can be concluded. Finally, all of the findings must be carefully weighed and evaluated, there being always, well to the fore, the recollection that any patient suffering from intra-abdominal distress may be suffering from intestinal obstruction, and that the possibility is not such a remote one at that.

The important thing is to recognize that an obstruction is actually or possibly present, or that some other definitely surgical intra-abdominal pathology which resembles it is actually or possibly present. A differential diagnosis, while desirable, is not essential, for the reason that if cardiac, pulmonary and renal disease be eliminated (and their elimination is not difficult) any other intra-abdominal condition which can be confused with intestinal obstruction is amenable only to surgery. It is a safe rule to follow that any abdominal pain which lasts more than six hours in a previously well person, especially if it is accompanied by any of the signs and symptoms we have enumerated, and if it is not permanently relieved by a single small dose of morphia, is evidence of a pathology which can be corrected only by operation.

The location and type of the obstruction are likewise of little moment. The small bowel is more likely to be implicated than the large, and it is Carson, I think, who points out that the higher the obstruction the more constant the symptoms, especially vomiting, while the lower the obstruction the more constant the signs, especially meteorism. Again, obstructions of the small bowel are more likely to exhibit a sudden onset, almost the only exception being volvulus of the sigmoid, while obstructions of the large bowel are more likely to present a previous history of digestive disturbance. Herniae, at least of the external variety, carry their own diagnosis. The history of a previous operation is highly suggestive of the existence of bands or adhesions. Impacted gallstones are always preceded by a typical history of digestive disturbance, and the same history, plus loss of weight, suggests malignancy of the large bowel. This is probably the most common cause of obstruction in the aged, and it almost always presents itself as an acute obstruction superimposed upon a chronic one. Rapid and enormous distention, sometimes to the point of respiratory embarrassment, is pathognomonic of volvulus of the sigmoid. Mesenteric thrombosis is prone to occur in middle-aged individuals, more commonly men, of a phlethoric type, and to be associated with immediate shock and a raised leukocytosis. All of this, however, though interesting and gratifying from the standpoint of diagnostic acumen, is beside the point. The conviction of intestinal obstruction, or the suspicion of it, is the one thing that is needful.

While the diagnosis is being considered,

the important thing is to stay one's therapeutic hand, to restrain one's "philocarthartic propensities." This is not always easy. An anguished patient and an anxious family may be insistent for relief, but this is one set of circumstances in which nihilism is true wisdom. Opiates serve only to mask symptoms, and purgatives, as Haggard well observes, simply "compound the felony of delay." By increasing a peristalsis that is already too active they serve to augment the distention of the overtried bowel, and to increase its bacterial activity, while if the stomach, and very properly, refuses to tolerate them, the body, as the result of increased vomiting, is still further depleted of its fluids.

At operation three principal problems arise: the correction of the actual obstruction, the management of the damaged bowel, and the combating of toxemia. In most early cases, unless an associated paralysis complicates the issue, simple relief of the obstruction is sufficient, but in advanced cases, as we have already pointed out, considerably more is involved than the interruption of the fecal current. Moreover, we must guard against harming the patient by the very means we employ to relieve him: in the late stages of the disease the mere relief of the obstruction is fraught with danger, permitting, as it does, a rush of toxic substances into the hitherto intact bowel or the return of the circulation to an already necrotic loop. Finally, even if the patient be relieved of his toxemia by drainage of the bowel and other adjuvant measures, he may still die of the unrelieved primary obstruction which, in his critical condition, it would be fatal to attempt to rectify.

It is plainly impossible to speak categorically of a disease in which each case must be judged upon its own merits. For working purposes, however, we can advantageously employ Sir William Taylor's very logical classification of cases, based, as is so much in this dread disease, on its duration. The condition of the patient is the determining factor in deciding upon the type and extent of the procedure. In the first group he is seen early and operated on promptly; his condition is good, and simple relief of the obstruction most often suffices for a cure. In the second group he is seen later; his condition is still fairly good, but toxemia is either an actual or a strongly probable complication, and drainage of the bowel is done in addition to relief of the obstruction. In the third group he is seen late, indeed often he is frankly moribund, and his toxemia is so overwhelming that the primary obstruction is lost sight of. Operation is done only because even a dying patient deserves his chance for life, slender though that chance be. Drainage of the bowel, through the first presenting loop of jejunum, is the only procedure warranted. If the patient survives, and most often he does not, the primary obstruction can be dealt with at a later date.

The high mortality reported after enterostomy, either alone or combined with other procedures, is no more an argument against it than is the high general mortality of intestinal obstruction a reflection on its surgical management. It is employed only in frankly bad risks, and where control series have been fairly studied, a definite reduction in the mortality has always been noted. Moreover, jejunostomy, if done by the Witzel technic, escapes the disadvantages usually attributed to it, the loss of digestive fluids and the development of fistulae which require later tedious closures.

As to other procedures, invagination and plication of gangrenous or suspicious areas of the bowel wall is a dangerous operation (indeed, a gangrenous bowel, whether drained or undrained, should never be left within the abdomen) and its apparent conservatism results in a higher mortality, in most instances, than the frankly radical procedure of resection. The latter, many surgeons believe, is indicated in every case in which distention and toxemia, with their consequent paraly-

sis, play a part, but except in very high obstructions, when loss of the digestive fluids would be a serious consideration, the two-stage operation is better than immediate anastomosis.

Operation for intestinal obstruction, I need scarcely point out, is anything but a simple procedure. The utmost manual dexterity is necessary, for, as Bunnell says, every manipulation, necessary or unnecessary, is " a shove nearer the grave." The least that can be done is the safest for the patient. It may be a highly satisfactory thing to complete a perfect operation, but it is a highly unsatisfactory thing to complete it on a corpse, and these patients have a disconcerting way of dying on the table, under one's very hands. In short, surgical judgment here comes into its own. To speak very bluntly, only an experienced surgeon has a right to undertake operation for such a condition as this, in which craftsmanship means much, in which knowledge means much, but in which wisdom, which is the application of knowledge, means even more. Like Lord Moynihan, I stand amazed at the ready acceptance by patients "of the eager ministrations of incompetent operators," when it would be quite as easy to secure adequate skill and experience, both of which are here taxed to the limit.

In the average case of intestinal obstruction there is no time for the rehabilitation of the patient, at least as we commonly understand the term. Two things, however, must not be omitted. Gastric lavage must be instituted and must be repeated until it returns clear, and it is a wise precaution, too, to leave the tube in situ during anesthesia, lest, when the glottic reflex is obliterated, the patient drown in his own secretions, or lest, later, he develop an aspiration pneumonia. Parenthetically, I might add that in spite of all the arguments against it and in spite of all the advantages claimed for other types, my own preference is still for general anesthesia, even for ether, admittedly the least auspicious of them all. In both local and spinal analgesia, it seems to me, the inevitable prolongation of the operation and the inevitable additional manipulations and trauma, which increase the shock of an already badly shocked patient, outweigh all the advantages claimed for them.

In the second place, hypertonic salt solution must be promptly given, preferably by infusion, to restore the fluid balance and to replace the lost chlorides, if this loss can be demonstrated; otherwise isotonic saline, as suggested by Selling Brill, may be employed instead. The use of saline, altogether with infusions of glucose and insulin, is continued after operation as long as the indications, based on the patient's clinical condition and the laboratory findings, warrant it. Other postoperative measures are employed according to the exigencies of the special case.

One or two other therapeutic measures might be briefly mentioned. B. W. Williams and Zachary Cope in England, and Bower and Clark in America, have reported striking results in a limited number of cases by the use of anti-gas serum. Williams first called attention to the striking likeness between gas gangrene and the terminal toxemia of intestinal obstruction and suggested that this similarity might be due to the actual presence of the toxins of B. Welchii in the fecal contents above the obstructed bowel.

Wagner in 1922 first pointed out the application of the effect of spinal analgesia in increasing intestinal peristalsis, and since that time this measure has been employed sporadically to overcome the paralysis of intestinal obstruction. The results have been very uneven and the issue has been clouded by the bad effects inherent in this special agent. Working from these premises, Ochsner and Gage, of the Department of Surgery of Tulane University, have recently suggested the substitution of splanchnic analgesia for spinal, on the ground that it is free from the disadvantages of the latter type, and

that, if the method of Kappis be employed, it is not necessary to open the abdomen to administer it. Their claim is that in those cases in which paralysis continues after relief of the obstruction, with or without drainage of the bowel, the mechanism being the inhibition of intestinal motility resulting from impulses passing by way of the sympathetics, this type of analgesia will overcome the paralysis by blocking the reflex and thus abolishing the inhibition. It must, of course, be employed only after mechanical relief of the obstruction. Prior to that time there is present a hyperperistalsis, and there is no advantage to increasing it. If the clinical application proves as satisfactory as the experimental work has been, we have reason to hope that we shall have in our possession a most valuable weapon with which to combat the hitherto invincible paralysis of intestinal obstruction.

The conclusion of the whole matter is that the prognosis of intestinal obstruction, as well as the rationale of its treatment, is absolutely dependent upon the time element involved. The mortality rises approximately 1 per cent with each hour of procrastination, and any mortality over 10 or 12 per cent can be charged only to delay. The death rate, which is popularly quoted as 30 or 40 per cent, actually is 55 or 65 per cent, and we are only stultifying ourselves when we refuse to face the true figures. In fact, it is very little lower today than it was forty years ago, when Fitz and Senn did the pioneer work in its study, and when medical treatment for forty-eight hours was the accepted rule. Medical treatment is not the rule today. Surgery is universally admitted to be the only rational and possible treatment. The trouble is, however, that in a lamentable number of cases our practice does not accord with our theory. And it is this sorry state of affairs, with its resulting almost criminal mortality, which must be my excuse, if excuse be needed, for having presented to you in this paper a subject to which, I am quite aware, I have added nothing new, but which, I am likewise certain, can be clarified and elucidated only by ceaseless iteration of the tragic facts of the case.

STUDIES IN THE EMBRYOLOGY OF BONE DEVELOPMENT*

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BONE development in the human embryo can best be understood by actually seeing the bones in situ in the various stages of development. The method used to show these changes embodies two principles, one the depigmentizing of the soft tissue, and the other, the staining of the bone tissue.

The depigmentizing was accomplished by a prolonged process through various strengths of potassium hydroxide, and the standing of the bone was done with an alcoholic extract sodium alizarin sulfonate in a 1 per cent potassium hydroxid.

Before the actual process of depigmentizing is employed, a preliminary bleaching, fixing and hardening of the material is necessary. The material, as soon as obtained, is best put into 70 per cent alcohol. Upon arrival in the laboratory, it should immediately be transferred to iodine alcohol, which is prepared by adding enough crystals of iodine to 95 per cent alcohol to impart a deep iodine color. After remaining in iodine alcohol for two days, the material should be then placed in 2 per cent aqueous potassium bichromate solution and left there in the dark room for thirty-six hours. Next, after washing in cool, running tap-water for two hours, the material is placed in 50 per cent alcohol and left there for three hours; after this, it is transferred to 95 per cent alcohol, in which it is allowed to remain for two or three weeks. During this time, the alcohol is changed as frequently as is necessary in order to keep the alcohol reasonably clear. At this stage in the preparation of the material, it is advisable to hemisect and eviscerate the fetus.

Now the material is ready for depigmentizing. The agent employed is aqueous potassium hydroxid which is changed twice a week. The percentage varies from ¼ per cent for a very young fetus up to 4 per cent for a full term fetus. The best results are obtained when the specimen is kept in the sunlight; the reason for the favoring action of the sun's rays is not determined. The alpine rays can be excluded as a factor, because they do not penetrate the glass jars in which the specimens are contained; apparently the heat of the sun's rays is a very important factor, as determined by the fact that depigmentizing proceeds more rapidly in an incubator at 37.5 C. then at room temperature. However, it has been determined that there are bleaching rays in the sunlight which penetrate the glass of the containers, and are important adjuvants to the heat in the bleaching process.

When the depigmentation has advanced to the point that the ribs of the fetus become readily visible, the specimen should be stained. The basis of the stain is a saturated solution of sodium alizarin sulphonate in 95 per cent alcohol. Such a saturated solution has a golden color quite similar to that of the dry powder. The final staining reagent is prepared by adding the saturated alcoholic extract of the dye, a little at a time, to a 1 per cent potassium hydroxid solution, until a deep Burgundy wine color is obtained. The time required for staining varies from six to twenty-four hours, depending upon the age of the fetus. After the staining process is complete, the fetus is washed in cool running tap-water for one hour. Then the specimen is placed in a mixture of 5 per cent glycerine and a percentage of potassium hydroxid equivalent to that used for the initial depigmentation of the specimen. After remaining in this solution for several days, enough of the stain will have dissolved out of the soft tissues of the fetus to rather markedly color the solution. (From now

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on, the solution is changed at about two-day intervals, the amount of alkali at each change being very gradually reduced, prevent fungus growth (in one specimen, there were several colonies of penicillium glaucum, a black mould, growing on the

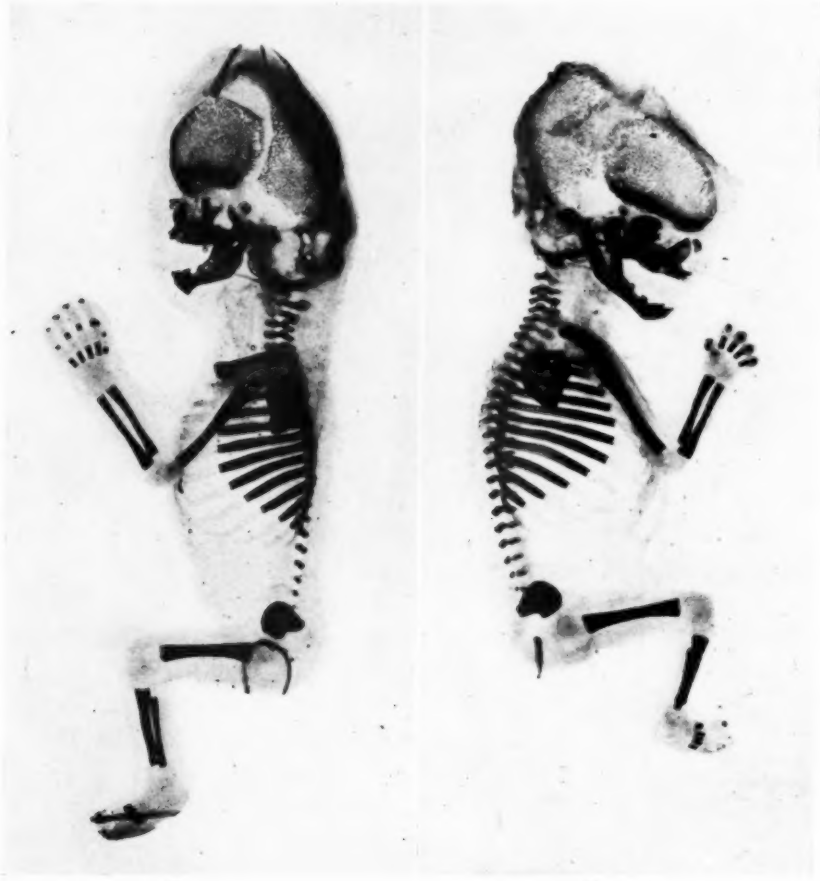

Fig. 1. Fig. 2.

Figs. 1 and 2. Three months' fetuses, stained. Length 9.5 cm. prior to preparation.

and the glycerine somewhat more rapidly being increased in amount. When a concentration of 25 per cent glycerine is attained, the hydroxid should be discontinued; at this stage the depigmentation should be nearing completion. After seven days in 25 per cent glycerine, the fetus is transferred to a 28 per cent ammonium hydroxide solution and left there for two days; then the specimen is put back into 25 per cent glycerine, and at weekly intervals is transferred to increasing percentages of glycerine until a concentration of 100 per cent is attained. After several changes in 100 per cent glycerine, the specimen is mounted in this latter reagent, to which is added a crystal of thymol to 100 per cent glycerine to which thymol had not been added).

Larger fetuses require some variation in the described technic. Usually after the fifth month there is much subcutaneous fat which markedly interferes with the clearing of the specimen, and requires special technic which is best employed at the end of the hardening process, before using the hydroxid. This variation consists in changing from 95 per cent alcohol to acetone, in which latter reagent it is left for several days; then to an acetone-xylol mixture and gradually increasing the xylol until 100 per cent xylol is used for several hours to several days, and then working backwards through xylol acetone to alcohol. This

method usually clears the fat, but a large amount of shrinkage of the specimen is unavoidable.

Fig. 3. Roentgen-ray of three months' fetus with resistance.

The process of depigmentation and staining is a time-consuming one. The smallest embryo, of ten to twelve weeks, requires about three months, and progressively with the increase in age of the fetus the time element is lengthened so that a full term fetus requires approximately two years for completion.

In the completed specimen, the entire bony skeleton system is visible, as well as the cartilage that has some calcium in it. One can easily distinguish cartilage from bone, the bone taking a definite red opaque color and the cartilage a brownish translucent hyaline-like appearance. The skull bones especially are brought out very distinctly. As early as the third month the tympanic ring can be seen to be definitely calcified. The ossification centers are easily traced and studied, and a truer conception of the gross difference between the cartilage and membrane bones is had from these stained specimens, than can be obtained from the finest roentgen plates.

The basis for development of the bony tissue, of which there are two types, is embryonic connective tissue. In one type

Fig. 4. Four months' fetus, stained. Length prior to preparation 17 cm.

of development cartilage precedes the bone and in the other, membrane formation precedes the bone. In intramembranous ossification the calcium salts are deposited in ordinary embryonic connective tissue. In intracartilaginous ossification, hyaline cartilage first develops in the same general shape as the future bone and the calcium salts are afterwards deposited within the mass of the cartilage.

The membrane bones, for example many

of the flat bones of the skull and face, are ossified by bundles of connective tissue fibers becoming impregnated with calcium

Fig. 5. Three months' fetus, stained. Length 9 cm. prior to preparation. Showing osteochondritis and poor bone calcification.

salts. These calcified bundles are calcification centers. These bundles are clearly demonstrated, especially in the younger of the stained specimens, as shown on the photographs and roentgenograms. In each of these areas, the cells increase in number, the tissue becomes very vascular and some of the cells become more oval with distinct nucleus and considerable amount of cytoplasm, then arrange themselves in single, fairly regular rows along the bundles of calcified fibers. These cells are known as osteoblasts and the whole tissue is known as osteogenic tissue. Under the influence of the osteoblasts, a thin layer of calcium is deposited between the osteoblasts and the calcified fibers. In this way true bone is formed. On the inner surface of newly formed bone, osteoclasts cause dissolution, while new bone is being formed on the outer surface especially under the periosteum, where the osteoblasts are numerous, thus causing growth and enlargement of the bone.

Fig. 6. Enlargement of lower extremity of fetus in Figure 5, showing osteochondritis in tibia and lack of calcification in fibula.

Intracartilaginous ossification, physiologically, is similar, but for the fact that it is performed by cartilage, shaped similarly to the future bone. The ossification center is usually single in these bones (the sternum is one exception, having several centers of ossification). The ossification center is in the center of the bone, especially as seen in the long bones, and the osteogenic tissue pushes in both directions toward the end of the cartilage (in the long bones towards the epiphysis). Summarizing, ossification in cartilage consists of the following stages: (1) multiplication of cartilage cells; (2) calcification of the cartilage; (3) absorption of the

calcified cartilage, and (4) deposition of true bone, that is, calcified fibrous tissue, round cells and osteoblasts which have

Fig. 7. Roentgenogram of three months' fetus, superimposed over normal pelvis roentgenogram.

invaded the calcified cartilage from the marrow.

The lime salts are stored in the bones the same as glycogen is stored in the liver and can be taken out of bone if needed by other part of body in the same manner. The calcium is carried by the blood stream to the bone. An old theory was that the maternal blood caused supersaturation of the calcium in the fetal blood and this caused the calcium to be deposited in the bone tissue of the fetus, because circulation in this region was more sluggish. This theory, however, was not substantiated in any way, because there was no scientific reasoning behind it.

An important rôle in carrying calcium salts to the bone is played by a hexose monophosphoric ester, which forms soluble salts with the calcium. This hexose monophosphoric ester is a normal constituent of circulating blood and in turn depends on the glucose of the blood. Under the action of a ferment which is present in ossifying cartilage, this calcium salt is hydrolyzed and calcium phosphate with a certain amount of calcium carbonate is precipitated in the matrix around the osteoblasts. The identical ferment is found

Fig. 8. Roentgenogram of five months' fetus, superimposed over normal pelvis roentgenogram.

in the intestines and kidneys. In the gut it joins the calcium, phosphate and sugar to form the soluble calcium hexose monophosphoric ester, and in the kidney it may be responsible for the secretion of the phosphate in excess.

The manner in which these various inorganic constitutents are combined in bone, whether chemically or physically, is not known, but it is probable that the calcium carbonate and calcium phosphate are united, and it is possible that magnesium phosphate is included in the same molecule.

The drain on the mother's calcium and sugar is thus easily visualized. It is interesting in this connection, that after phosphorus poisoning a patient craves sugar, which no doubt is due to loss of body sugar in eliminating the phosphorus.

The true etiology of congenitial variations and anomalies has not as yet been ascertained with any degree of exactness in most cases. A few years ago fright, seeing horrible sights and other superstitions were blamed for congenital defects, especially monstrosities. The conditions recognized as capable of modifying bone development are:

(a) Germinal and prenatal infection with Treponema pallidum
(b) Congenital rickets

Fig. 9. Roentgenogram of full term fetus (shrunk by process), superimposed over normal pelvis roentgenogram.

(c) Infarcts
(d) Oligohydramnios
(e) Chrondrodystrophia fetalis
(f) Osteogenesis imperfecta

True germinal infection implies that a disease-producing microorganism is carried by the ovum or the spermatazoa and incorporated in the embryo prior to its development. It has been claimed that syphilis may thus be transmitted by the male to the ovum in utero, the mother remaining uninfected by the disease. In prenatal infection the organism must pass the placental barrier. This implies that the fetus becomes infected directly from the maternal blood stream or by continuity of growth of the organism through the placenta. The placental form of infection is not conceded by all observers, but it is reasonably certain that congenital lues can be contracted thus.

Bone lesions of late congenital lues and acquired lues are distinctly different from those of fetal and early congenital lues. In the early type the disease affects chiefly the ends of the long bones. In late lues, it affects the flat bones with gumma and bone destruction (gumma, necrosis and caries sicca) and bone proliferation (osteosclerosis and osteoperiosititis).

A child with early congenital lues may show the deformity at birth or not until a later date, although infection may be present. The infection in all cases, except germinal, if there is such, is hematogenous.

The Spirocheta pallida or treponema of Schaudinn exerts certain effects on the fetal skeleton. The characteristic skeleton lesions are not seen before the fifth month according to Keith, and thus the many luetic miscarriages on the third month of pregnancy would show nothing. However, the picture of the prepared specimen of a third month miscarriage of luetic parentage shows definitely osteochondritis of the tibia (diagnosis confirmed by Dr. Archibald Murray, fetus aged three months).

The osteochondritis here is shown by the abnormal width and irregularity in shape, as well as irregular calcification of the distal end of the tibia and complete absence of calcium in the fibula. Normally a fetus of this size has well-developed bone. According to Hess, tibia and fibula are well ossified at ten weeks. The luetic condition caused the pathology already stated plus poor calcification throughout, making it possible to see on a large scale how the calcification centers appear in the other bones, which normally would have been at those stages about three weeks earlier, because of the delayed calcification. This specimen shows best when compared with the normal specimen of the same age which is shown here. In practically all prematurely born and prematurely stillborn children with congenital lues, luetic bone changes are found. These may be accompanied by skin and mucous membrane changes which appear at the eighth month of pregnancy.

One of the most important anatomical

signs of syphilis is syphilitic osteochondritis which often renders anatomical diagnosis possible, if the other symptoms pointing to lues are absent. When seen, it may be difficult to prove even clinically at times, but it is most always a sign of latent syphilis in such cases. Syphilitic osteochondritis leads to a widening and irregular formation of the zone of calcification which is indistinctly outlined against the epiphysis and sends out jagged offshoots into the latter. This lesion occurs most frequently in the distal end of the femur, then in the tibia and fibula, and then in both bones of the forearm. Osteochondritis may occur, however, in flat bones.

Levaditi, Hoffman and Bertarelli frequently found Treponema pallidum at or after the fifth month in osteochondrotic tissue.

Periostitis ossificans is also found occasionally in congenital lues.

Congenital rickets is thought by some to be only a congenital predisposition to rickets, while another school thinks, and has good evidence to prove, the presence of rickets in the fetus in utero, caused by the same factors as produce rickets later on.

In rickets there is accelerated multiplication of cartilage cells and a retardation in the deposition of true bone resulting from a failure in deposition of the calcium salts. It is evident that in the causation of rickets or, for the growth of normal bone, many factors are involved. In the first place, the presence of vitamin D is essential. This may, however, be replaced to a certain extent by exposure to sun's rays or to ultraviolet light. Then it is necessary that calcium salts shall be present in proper proportions. Deficiency of calcium and phosphates in diet may hinder the formation of bone.

Infarcts of the placenta may modify the development of the entire fetus, thus modifying the bone development at the same time.

Oligohydramnios might modify the development of bone, by producing intrauterine amputations or pressure deformities.

Chondrodystrophia fetalis or micromelia is shortness of limbs. Changes in the skeleton are derived essentially from retardation of the epiphyseal growth of the bone, with normal periosteal growth. The structure of the bone produced with the periosteum is very dense, and results in the coarse sclerotic quality of the bone. The formation of synostosis takes place in the synchondroses and syndesmoses. The junctions of the epiphyses close prematurely, and the further growth in length is impeded by the coalescence of the latter. The cause of the disturbance is thought to be a disturbance in the internal secretory equilibrium, with evidence that in these fetuses there are generally insignificant, but frequent changes in the thyroid, liver and genital development. However a living infant born at the Long Island College Hospital in the month of April, 1929, was typical of micromelia, especially marked bilaterally in the humeri and femora, yet apparently there were no gross thyroid, liver or genital changes observable. There was a slight degree of hydrocephalus. The mother was normal in every respect physically.

In osteogenesis imperfecta, the most characteristic symptom lies in the abnormal brittleness of the bones, and after birth such children exhibit multiple incomplete fractures, due to the thinness of the cortical bone layers. The extremities may be bent in a circle, due to fractures. Otherwise the condition of the child presents nothing abnormal. The cause of this condition is not known.

Roentgenograms may be used *per se* to determine the bone development, and the roentgen ray bears an important part in the medico-legal aspect of obstetrics. The stained specimens present detail and relationships in three dimensions, so that when used as controls, and checked over by roentgen rays, one can more fully read and comprehend the roentgen ray picture.

The stage of ossification of the skeleton of a fetus, as observed in roentgenograms, is used practically to determine the age

of the fetus. This method however is far from accurate, and this can be easily shown by comparing the two pictures of the three-month-old fetuses. One has fairly good bony development, and the other, due to diseased condition, has marked retardation in calcium deposition. The centers of ossification in the diseased specimen are almost equal to that of the normal specimen, and therefore, using the number of centers of ossification as an index to age might be more accurate. These points are much more clearly visualized on study of the cleared specimens up to four months of age, because up to this age roentgen rays are very indistinct. Using the cleared specimens as controls, the study of these centers of ossification is greatly facilitated.

Mall, through a special technic proved in specimens under 100 days old that centers of ossification are present at least one week before they are demonstrable by roentgenograms. Anatomically these observations are definitely proved by the cleared preparations.

In the very early period of the second month the stage of ossification of the clavicle and the mandible is of chief importance.

The results used for comparison are from the combined findings of several years of laboratory work, the chief details of the modus operandi having been stated at the beginning of this paper, supplemented by a large number of photographs and roentgenograms. The photographs were taken in a dark room by means of transmitted light. The roentgenograms required careful study so that detail and contrast could well be brought out, the best result being had with high milliamperage and increased distance of the object from the target. The smallest specimen, three months of age, was best at 40 ma. distance of 36 in. and time ¾ sec. The full term fetus showed best at 40 ma. and 36 in. distance and the time at exposure was 2 sec. This technic gives the best black and white contrast.

SUMMARY

There are several possibilities for use of the data given here.

1. The observer can have an open view of the study of the progress of the development of bone in the fetus.

2. The relationship of the bones to each other and to the rest of the body can be studied in true anatomical position.

3. The results can be used in obstetrics especially in roentgen ray work, the stained specimens acting as controls as far as detail and number of calcification centers are concerned, as an aid in judging the size. The truest picture of fetal changes is obtained by a detailed study of the stained specimen, especially in the earlier months. Roentgen pictures of the fetus taken at the same period show a marked lack of detail when compared with the stained specimen. The possibilities in this are great, and a decided increase in efficiency in obstetrical diagnosis in the early months of pregnancy may be obtained by careful comparisons of the roentgen ray plates with the stained specimens, for the purpose of so perfecting the roentgen ray technic that it may bring out details which are now only observable in the stained specimens.

In the special work, roentgen rays of specimens of all ages were superimposed over the roentgen rays of the normal female pelvis, and the results are clean cut. One may argue that with the fetus in utero the conditions are different and there is greater body resistance with greater chance of distortion and absorption of the roentgen rays. There is some truth to this argument, but the results had from ordinary roentgen rays, and the roentgen rays of the fetuses when studied out carefully with regard to the various factors of distance, time and milliamperage, compared with the stained preparations, show that the earlier roentgen ray diagnosis can be made more certain.

4. Earlier determination of bone pathologies of the fetus in utero, especially of luetic osteochondritis when lues is

suspected, are made possible even though clinical data are missing.

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EMBRYOLOGY, ANATOMY AND SURGERY OF THE PROSTATE GLAND

WITH REPORT OF OPERATIVE RESULTS*

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AMONG the various structures which make up the genitourinary tract the prostate gland has, until recent times, remained something of a mystery. By the earliest anatomists it was regarded as a urinary organ, and after its identification as a part of the generative system, its anatomy, histology and function were imperfectly understood, and its pathologic manifestations remained a vexatious problem to students of urology right up to our own time. Indeed even now many of the points that these students have from time to time brought forward for elucidation are still unsettled, and capable of stirring up a considerable amount of acrimonious partizanship when brought up for discussion, a sure proof that we have still a good deal to learn about this diminutive but highly important part of the male organism.

When I first entered upon the study of prostatic anatomy and physiology, a review of the existing literature revealed an amazing divergence of opinion, especially in the department of embryology, the particular rock upon which unanimity always seemed to be shipwrecked being the integral relationship of the "middle lobe" to the rest of the structures about the vesical neck.

EMBRYOLOGIC DEVELOPMENT

My investigations of prostatic embryology were carried out upon specimens varying in age from ten weeks to full term, and study was further visualized by the construction of a wax model of the human prostate gland as it appears at birth.

The study was begun with a fetus 5 cm. in length, estimated age ten weeks. At this stage of development the bladder is a cylindrical tube made up of embyronal connective tissue, joined near its base by the two ureters. These two ducts pass through the wall of the cylindrical bladder, and the muscle fibers which form them extend so as to be superimposed upon the vesical wall, thus forming the trigonum vesicae. No tissue which in any way resembles muscle is to be detected, nor can one distinguish the area which will later on be occupied by the vesical sphincter, except that alternation in the size and shape of the lumen is evident. In a fetus of thirteen weeks' development, however, this muscular development has been initiated, for circular interlacing of the fibers has commenced, longitudinal strands of tissue which take on a deeper pink color than that assumed by most of the connective tissue of the vesical wall being in evidence. The bladder base has thickened until it is deeper than any other portion of the circumference, and the wall beneath the trigonal area with the overlying trigonum vesicae has a depth five times that of the anterior wall. It is now possible to trace the trigone's muscle fibers from between the two ureters down upon the remainder of the trigone, and it is noticeable that their texture is much finer than that of the fibers of the vesical wall proper. An abrupt narrowing in the circumference of the lumen indicates where the vesical sphincter will shortly emerge as an entity and at this period of development also, a few muscle fibers displaying the circular arrangement are in evidence.

By the time the sixteenth week of fetal development is attained there is a great advance in formation of bladder muscle, the difference between muscle fibers and

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connective tissue being sharply defined. The fibers forming the vesical trigone are in evidence from their place of emergence from the walls of the ureters, so that their course to the trigone area is easily traced, and in the specimen of this age which was examined, the mucosa was smooth and closely adherent to the trigone, though elsewhere it was arranged in folds. The constricted opening of the vesical neck was sharply outlined by encircling muscular fibers indicating the position of the vesical sphincter. In a specimen twenty weeks old there is a very great increase in the number and size of these fibers, so that the internal sphincter seems to be tightly closing the vesical orifice. All the muscular fibers are much more in evidence, the longitudinal ones running in among those upon the outside of the sphincter. Though folded every where else, the mucosa over the trigone is quite smooth at this stage.

In a specimen of twenty-two weeks' development the musculature of the bladder has undergone still greater augmentation, and the same is true of the interureteric bar. The relation between the size of the trigone and its underlying bladder wall to that of the remainder of the wall of this viscus has now changed, for this part of the wall has not enlarged as rapidly as other sections; the fibers forming the trigone show a closer binding together than those of the rest of the bladder, while the mucosa covers it smoothly; the sphincter, though large, is in very close relation to the rest of the vesical musculature. At the thirtieth week and at full term the muscles of the bladder wall will be found to have increased still further in size, for at birth the sphincter is very thick in its posterior quadrant, and shows its greatest dimension at the upper margin. At this time many of the muscle fibers, instead of circling the orifice, mingle with those showing a longitudinal arrangement which originate on the anterior surface of the bladder. The fibers visible at the outermost part of the sphincter are not now so numerous, but those in evidence entirely encircle the opening.

It is not until the third month of fetal life that there is evidence of development of the prostate gland. At this time solid epithelial outgrowths make their appearance from five distinct parts of the prostatic urethra. These solid masses are made up of cells which stain very deeply, and very early these assume a circular arrangement forming a lumen and branches and thus producing the tubules which are the prostatic nucleus. From the five different points of origin there thus arise five groups of tubules, the first lying on the floor of the urethra between the vesical neck and the orifices of the ejaculatory ducts and prostatic utricle; the second and third on on either side the urethra in the prostatic furrow; the fourth just below the point where the ejaculatory ducts and utricle open into the urethra, upon the urethral floor; and the fifth in the prostatic urethra upon the ventral or anterior wall. By the development of these tubules and their enclosure in stroma, there eventually arise five lobes, namely the middle lobe, right and left lateral lobes, posterior and finally, anterior lobe. Widely separated in the early stages of embryologic development, the distance between the middle and two lateral lobes is greatly diminished in later fetal life. None of the specimens studied showed any actual intermingling of the tubules, but after birth the middle lobe and lateral lobes lay side by side, with no definite separating capsule between them. The posterior lobe, however, was entirely distinct, a dense layer of fibrous tissue separating it from the lateral lobes, and the anterior lobe was at a considerable distance from the two lateral lobes, separation being quite complete.

The youngest fetus examined showed no sign of muscular fibers about the prostatic tubules, but at the sixteenth week a slight differentiation in staining properties was noted and by the twenty-second week there was considerable development of the muscle layers, especially at a point

where certain of the tubules of the lateral lobe extended away from the base of the prostate. This muscle structure constantly increases in thickness as older specimens are examined, until at full term an extremely dense layered structure surrounds some of the tubules.

The Middle Lobe. As one among the specimens examined in the course of this study had no tubules developed in the usual location of the middle lobe, the investigation was extended to adult dissection and autopsy subjects in order to determine the relative number of individuals who possess this portion of the gland under consideration. In all, 103 specimens were examined, and among these there was but one, the fetus in question, in which there was undoubted absence of glandular tissue in the middle lobe region, though in 5, 3 of which were seen at Guy's Hospital Pathological Museum, London, it was not possible to determine whether or not glandular tissue was present.

The middle lobe in all the fetal specimens examined was seen to develop independently from the group of tubules lying on the floor of the urethra, at a point between the bladder and the orifices of the ejaculatory ducts. In the younger specimens this group was a long way from those which were the origin of the lateral lobes, but as older specimens were examined, the area intervening in which no glandular elements could be detected gradually decreased until, though the tubules and their branches did not lose their characteristic position, there was no longer any distinguishable fibrous capsule separating the middle from the lateral lobes. As the structures of the verumontanum develop, the ducts of the largest tubules, originally close to the middle line, are displaced so that they open high up on its sides, their original position being occupied by the ejaculatory duct openings and that of the prostatic utricle. The average number of tubules in the middle lobe, in this study, was found to be ten.

The Lateral Lobes. The number and size of the tubules composing the lateral lobes were found to be greater than in any of the other lobes. The lateral lobe tubules originate on the lower part of the lateral walls from the right and left prostatic furrows, forming the major part of the prostate's base by backward and outward extension. Though there is always a certain degree of separation between these lobes, it is much greater in the early specimens, the nearer the full term of gestation is approached, the less definite this separation becomes, except at the point where the ducts communicate with the urethra, where the distinction always remains evident. The tubules always grow back toward the bladder, except in the apical region; here a few of the lateral lobe tubules send branches in a forward direction. In the one specimen where the middle lobe was absent, branches from the lateral lobes developed into the region which the middle lobe normally occupies. In a specimen from a new-born infant, the lateral lobes displayed two tubules which branched widely, so that they formed practically a glandular commissure by extending up into the region of the anterior commissure. Usually the lateral lobes show a considerable extent of stroma between their anterior protions, anterior lobe tubules being present in this stroma. A definite plane of connective tissue lies between their posterior branches and the posterior prostatic lobe, and mesially the ejaculatory duct, the urethra and the middle prostatic lobe intervene. The average number of tubules in the two lateral lobes was reckoned to be thirty-seven.

The *posterior lobe* was found present in every specimen examined, as an independent structure developing from tubules which are distant from those from which the other lobes develop, and divided from the other lobes by a definite capsule, only connected laterally with that enclosing the entire gland. The tubules of this lobe appear at the third month of fetal development together with those of the other glands, and are found on the urethral floor

below the openings of the ejaculatory ducts. They develop in a backward direction toward the bladder, thus advancing behind the ejaculatory ducts, and forming the major portion of the prostate's apex, the portion of the fully developed gland which can be palpated by rectum. The posterior lobe is separated, by a stroma of connective tissue containing no tubules, from the ejaculatory ducts and the posterior sections of the lateral lobes, although this stroma is not in evidence in the earlier months of fetal development. In this division of the prostate gland the tubules are relatively large and have numerous branches, but they are few in number, the average in six specimens being only eight. Their branches, like those of the tubules of the anterior lateral lobes, extend forward into the apical region.

The posterior lobe of the prostate is of especial interest to surgeons, for it has been established that it is the site of carcinoma, but that benign hypertrophy seldom takes place in it. We are indebted to the late John T. Geraghty and to Montague L. Boyd for studies in prostatic pathology which have supplied us with this information, and when we add to this the further knowledge gained by embryologic investigation, which shows that the tubules from which this lobe takes it origin are entirely independent of the other tubules forming the remaining prostatic lobes, it at once appears highly probable that the function of the posterior lobe may be distinct and different from that of the remainder of the gland. This view gains further confirmation when examination of the posterior lobe tubules in the fully developed adult, shows them to be much larger than others.

The *anterior or ventral lobe* enters upon its developmental stage at the same time as the other lobes, being formed of large tubules having numerous branches. The size of these tubules, however, does not remain relatively so large, for by the time development has advanced to the sixteenth week they are even somewhat smaller than the tubules of the other lobes, and by the twenty-second week they have decreased both in number and size, and appear to have lost most of their branches. In fact the anterior lobe becomes increasingly insignificant as development advances, until when full term is reached only two small tubules are in evidence. The anterior lobe may, however, persist to the period of full adult development, for among the adult prostates which were examined in connection with this study, numbering 93, 2 specimens came under observation in which hypertrophied anterior lobes were present. The average number of anterior lobe tubules in the fetal material examined was thirteen for the first half of the interuterine period, and six for the second half of this period. Kuznitzky reported the finding of a persistent ventral lobe in 1 out of every 15 adult prostrates which he examined.

Prostatic Duct Openings. One of the significant results of this investigation was that relating to the number of prostatic ducts which have openings upon the floor of the prostatic urethra. In the majority of textbook descriptions the number of these openings has usually been given as from twenty to thirty. I am convinced, however, that this estimate is far below the actual average. Summing up my findings in regard to this particular point, it turned out that no specimen examined showed less than fifty-three of these ducts opening into the prostatic urethra; 2 specimens showed as high as seventy-four, and the average for 6 specimens, in one of which there was no middle lobe, was sixty-three. And never, since I first published the results of my enumeration nearly fifteen years ago, have I seen any refutation of my figures, though many textbooks, even those which have undergone revision in the meanwhile, still continue to make the original estimate.

SURGERY

Great progress has been made in the surgery of the prostate gland in the past few years. A review of the steps marking

progress of surgery of the prostate gland is interesting. The problem of this particular field of surgery is complicated by the fact that all of the patients are men of advanced years.

The discovery of anesthesia and the application of the principles laid down by Lord Lister placed this branch within the limits of surgical aid along the usual lines. It was soon learned that the aged men, most of whom suffered from deficiency in renal power, tolerated ether poorly and various efforts were instituted to avoid the frightful mortality that resulted from this operation under ether.

It was early recognized that those patients, who were catheterized over long periods, if they survived, were in better condition for operation when it was finally performed. This knowledge led the progressive urological surgeon to institute some sort of drainage as a routine preliminary to operation. This drainage may take one of three forms:

(1) Regular catheterization once or twice daily

(2) Retained catheter per urethram, or

(3) Suprapubic drainage under local anesthesia.

Personally I prefer the last method because the other two are irritative and annoying to the patients and we find that even under the most careful precautions the patient will be inflicted with either a primary cystitis or a secondary exacerbation of an already existing infection.

The Urological Department of the New York Hospital is provided with suction in every room so that the patients are kept dry and comfortable by attaching the suction to the inner of a double tube which has been in use for many years. The urine rises in the large outer tube until it reaches the lower end of the small inner tube, which is surrounded by a column of air, and the patients abdomen is kept dry by this means without sucking the bladder wall into the end of the tube.

The general observation of the improvement in the renal power of patients by drainage was placed on a scientific basis by the development of accurate methods of measuring kidney efficiency. These methods have gradually improved, stimulated no doubt by the epoch-making work of Geraghty and Rountree on phenolsulphonephthalein in 1908. Various other tests are in use including cryoscopy, estimation of output of various substances, such as potassium iodide, sodium chloride and others. The color tests, phenolsulphonephthalein and indigo carmine, deservedly occupy the most important place among kidney efficiency tests in the order named. The Mosenthal concentration test is an important recent addition to this list.

Perfection of methods of estimating various retention products in the blood stream of persons suffering from inefficient kidneys is a most important addition to our investigation of the patient, preliminary to operation. By determining this retention, by estimating the excretion of urea in a twenty-four hour specimen and by doing a phenolsulphonephthalein test, one may get a true picture of the extent to which the kidneys are performing their function as eliminative organs.

The most important part of any operation upon the prostate gland is the preparation of the patient. This preparation consists of drainage by any effective method that is least annoying to the patient.

The patient having been properly prepared, as indicated by his laboratory tests and as shown by the observing eye of the operator, it is necessary to decide which type of operation one must use. It seems most unwise for the urological surgeon to close his mind to any type of operation. It can be clearly decided by the cystoscope or by digital examination at the preliminary suprapubic cystotomy whether the hypertrophic gland should be removed by the suprapubic route or through the perineum. Unless there is some specific reason for the gland to be removed subrapubically it would seem much more preferable to perform the perineal opera-

tion because while the latter requires more time and an intimate knowledge of the anatomy of the region, it is not nearly so great a shock to the patient. The reason for the shock accompanying the upper route is that there is always more or less pressure and traumatism to the complicated nervous plexuses over which one must work, thereby exerting an effect similar to a blow over the solar plexus, so familiar to everyone. The downhill drainage and the fact that the patient can be gotton out of bed in a chair after the third or fourth day are additional arguments in favor of the perineal operation of Young and its modifications and the excellent perineal operations of Voelker of Halle and Syms of New York.

Next to the preliminary drainage the choice of anesthesia assumes a much more important rôle than does the choice of operation routes. Ether is dangerous because it is extremely irritative to the kidneys, which even in the best of cases are already damaged. Chloroform is almost sure death, the patients succumbing in from six to ten days as a result of liver poisoning as shown by the experiments of George Whipple. Of the inhalation anesthesia, gas oxygen is the most serviceable, but there are very definite objections to it. Under all inhalation anesthesias the blood pressure is elevated very considerable so that the patient may be likened to an athlete at the height of his activities. This naturally gives rise to more bleeding and consequently to greater shock. Many attempts have been made to perform the operation under local or regional anesthesia. Of these methods two have survived. Spinal anesthesia as practiced by many urologists from time to time in this country and sacral anesthesia which has been lately modified by the addition of parasacral injections as well. The number of accidents under spinal anesthesia has been so great and so fatal that it has been largely given up by American surgeons. The results with sacral anesthesia have been so spectacular in a recent series of cases that it seems worth while to discuss the method in some detail.

F. Cathelin[31] and Durant (1902) used sacral anesthesia for the purpose of treating grave neuralgias, sexual neuroses, and incontinence of urine. The former first used plain water, salt solution and later added cocaine, novocaine, codeine or morphine. By this method Cathelin reported 49 per cent of the cases of incontinence of urine cured: 35 per cent materially benefited and 4 per cent failures. He failed in his attempts to completely anesthetize the sacral nerves in humans but was successful in dogs.

A. Lowen[32] used 20 to 25 c.c. of 1.5 to 2 per cent novocaine and placed the patient in a sitting posture for some minutes after injection with the idea of retaining the solution in the lower end of the vertebral canal. O. Gros[33] recommended the addition of sodium bicarbonate which he states permits the solution to readily penetrate the nerve sheaths. Strauss prepares a solution by the addition of sodium sulphate which he maintains prevents the decomposition of adrenalin, which he also uses. Hertzler recommends the uses of quinine and urea using 60 to 90 c.c. of 0.6 per cent solution. B. Lewis and L. Bartles[34] reported 48 successful cystoscopies out of 68 attempted and D. R. Pickens[35] reported 81 out of 100 attempted.

Splendid work on this subject has been done by Thompson of Galveston who follows the method described by M. L. Harris.[36] Albert J. Scholl, Jr.[37] used sacral anesthesia successfully in 140 cystoscopies out of 150 in which it was used. He used the method recommended by Labat.

The patients upon whom this type of anesthesia was first used by us were all cases in extremely grave condition.

All cases have been entirely successful except 6. In one of the latter, a seminal vesiculectomy, it was necessary to give a few whiffs of ether during the last five minutes of the operation. In another, that of a man of eighty-six years of age upon whom a perineal prostatectomy

was performed, a little gas or ether should have been used for about the same length of time. A third case was only moderately uncomfortable.

Untoward Symptoms. Two cases have had short periods of excitement. One had spasmodic contractions of the legs lasting about one minute. Two others became flushed and somewhat confused temporarily. Most of the cases have an increase in pulse rate and slight increase in blood pressure which lasts throughout the operation.

The untoward symptoms in our cases appeared immediately after the injection was given into the sacral canal and caffeine is always held ready for use in case a collapse occurs.

E. Zweifel[38] reported a death from cardiac and respiratory paralysis due to the injection of 0.8 gm. of novocaine into the dural space. His needle had penetrated the dural sac. B. Kronig[39] reported a case in which the novocaine was injected into the sacral vein. This was followed by a partial respiratory paralysis.

Preoperative Preparation. When first seen the patient suffering from residual urine should have his bladder partly refilled with boric acid solution or sterile water whenever catheterized. The amount replaced can be reduced gradually if the patient shows no toxic signs from this procedure. This is called "decompression" and is of vast importance in the prevention of uremia from the complete emptying of an overdistended bladder.

Following the period of decompression it is the practice of the author to do a suprapubic cystostomy for drainage, using a suction apparatus which drains the bladder by means of the double suction tube devised by Kenyon of the New York Hospital and recently modified by Harrah.

The indwelling catheter method of drainage has many objections. The intrusion of a foreign body through the urethra prevents the proper drainage of the fluid from the prostatic tubules and causes additional congestion of the prostate gland. There is sufficient absorption from the prostatic urethra to keep the patient a little below par at all times.

The suprapubic drainage under suction seems to be the ideal method of procedure as a preliminary to operations on the prostate.

It is an efficient method. The patient keeps dry, clean and odorless. Old men are very much like babies in that if they are dry, clean and comfortable they will thrive but if they are wet, odoriferous and uncomfortable, they, like babies, wilt and do not progress favorably.

By this efficient method of drainage the edema of the prostate is reduced, absorption does not occur and at the time of operation the hemorrhage is considerably reduced. By using a satisfactory binder the patient may sit up on his fourth postoperative day.

Vaccination of the patient by the organisms carried in his bladder occurs at the time of cystostomy. Thus we see that the shock of the prostatectomy is divided into two parts. Indeed the patient is usually more uncomfortable after the first operation than he is after the second.

The important thing about the length of time to be devoted to preliminary drainage is to have no set time for it. By a succession of blood chemical and phenolsulphonephthalein tests one determines when the patient has reached his maximum of renal efficiency. If at the same time the patient feels well and is anxious to proceed, the prostatectomy is then undertaken. One must continually bear in mind that we are dealing with human beings and regardless of the excellence of laboratory tests, if the patient is weak, decrepit or even has a headache it is wise to wait until he, like a well-trained athlete, is "raring to go." Also like athletes, patients waiting around a hospital may go "stale." This is reflected in the patient's well-being as well as his laboratory tests. Such cases must be postponed until they have entirely resumed a state of well-being. The shortest period

of drainage in our series has been eight days, the longest twenty-four months, while the average length of time is sixteen days.

Due to hemorrhage and infection the patient may have a badly depleted circulatory system. In such cases, transfusion, repeated if necessary, of moderate amounts of blood is particularly helpful.

Purgatives are administered the day before the operation sufficiently early so that the patient may have a good night's sleep. Sodium bicarbonate is administered in small doses for a period of two days before operation. Fluids are taken up to, during and immediately after operation so there is no dehydration of the patient.

Operation. The most important feature of an operation on the prostate gland is proper preliminary drainage. Next in importance is the anesthesia used and of least importance is the route by which one removes the gland.

General anesthesia should be avoided because it elevates blood pressure and hence there is more hemorrhage during operation. As soon as the patient recovers consciousness he has the pain caused by a fresh incision. These two factors, pain and increased hemorrhage, explain why eight times as many patients went into shock or bordered on it when we were using general anesthesia, than we see now.

The administration of sacral and parasacral anesthesia has been thoroughly described by us elsewhere. The method is easily and almost painlessly applied and has been used on many cases with almost no accidents. Its advantages are many. It is possible to get perfect anesthesia for perineal prostatectomy in 95 per cent of the cases, the remaining 5 per cent require slight reinforcement in some manner. Often the smelling of a little essence of orange or a few drops of ether sprinkled on a piece of gauze are sufficient to accomplish the desired results.

As far as one is able to estimate there is about $\frac{1}{10}$ the amount of bleeding as compared to the same operation under general anesthesia. The anesthesia persists for a period of six to eight hours after injection to a certain degree and for two hours for purpose of operation. This fact prevents postoperative pain to a large degree. Thus the main elements which go to make surgical shock are eliminated. Water is imbibed throughout, thus preventing dehydration.

The operation which we prefer is a modification of Young's perineal operation. The splendid tractor devised by Crowell is first passed into the bladder through the urethra. Its blades are then opened. After making a semilumar incision through the skin the two spaces on each side of the central structures are opened by sharp and blunt dissection. The central tendon of the perineal muscles are then incised *behind* the point where the lateral perineal muscles join it. This allows the central structures to be pulled upward with the bulb and lateral perineal muscles. A Kocher clamp is fixed to the posterior part of the central tendon and held in the left hand for the purpose of traction. The index finger of the left hand is inserted into the rectum and the hand covered with a towel. The dissection is carried deeper and the important reflection of the levator ani called the rectourethralis, attaching the rectum to the urethra at the apex of the prostate, is then incised. The levator ani is then dissected from the posterior surface of the prostate which is recognized by the glistening fascia of Denonvillier which covers its posterior surface. It is thus noted that not only has the posterior urethra not been opened but often it is not even seen, which is an extremely important point in the prevention of incontinence. The left index finger is now removed from the rectum and the glove changed, a posterior retractor being placed in position.

The prostate is now opened by making an inverted v slit in its posterior surface, the apex of the incision reaching the exact apex of the prostate and being carried

down to the urethra itself. When this flap is drawn back the verumontanum is seen and a transverse incision is made in front of it. This is deepened by blunt dissection which separates the middle lobe from the posterior lobe with its dividing fibrous leaflet which carries the ejaculatory ducts through the prostate. This procedure leaves the ejaculatory ducts uninjured and still retaining their normal orifices. These facts account for the low incidence of epididymitis following our procedure.

The enucleation of the gland is now continued by separating the hypertrophied portion presenting from the capsule. The index finger is introduced into the prostatic urethra and the so-called anterior commissure split, being careful not to injure the internal sphincter any more than absolutely necessary. If the internal sphincter is split at the top there is grave danger of tearing into the plexus of Santorini with resulting hemorrhage.

The Lowsley clamp is now used to grasp the hypertrophied structure and the enucleation completed.

The vesical orifice is grasped with an Allis clamp, the Crowell tractor closed and removed and the finger of the operator introduced into the vesical orifice to identify and remove any remaining tags of tissue or a subcervical gland enlargement. Pieces of prostatic tissue as big as a lime are removed with the author's clamp through the vesical orifice without difficulty. Particular attention is paid to the thorough removal of small nodules of prostatic tissue and to tags of fibrous material as well. These half-destroyed tissues will remain as a future menace to the free passage of urine or become necrotic and offer a fertile field for the infection of the entire prostatic cavity.

A Pezer tube, size 26 F., is introduced into the bladder through the urethra and fixed in position by means of adhesive. The vesical orifice and prostatic cavity are now thoroughly packed with vaseline gauze, enough being used so that the bleeding is entirely stopped on the table. The floor of the pelvis is closed by drawing the two sides of the levator ani muscle together with a catgut suture. The skin is closed with silkworm gut.

Postoperative Course. We have had only one death attributable to the anesthesia. In the first series there were 2 cases that could not have been operated upon except by means of sacral anesthesia as they were in no condition to withstand inhalation anesthesia of any sort. In the last series of 19 patients there is one such case. We have felt for sometime that blood pressure observations were much more important in the postoperative tests than any other feature of immediate recovery. It has been a surprise and delight to observe this series of cases. In none of the second series has the blood pressure dropped below 100 mm. Hg. and all of them have shown a tendency to rise at the danger period, about six hours after the operation. We have not found it necessary in any of these cases thus far to give stimulation to the circulatory system either by means of drugs, intravenous infusion of gum-glucose or any other substance.

The general appearance of the patients on the day following operation by this method is suprisingly good and it would seem that the shock to the entire body mechanism is very considerably reduced by avoiding inhalation anesthesia. There have been no late developments such as headache, paralysis or other alarming effects. Thus far our patients seem to improve from the zero postoperative hours (six to ten hours after operation) without interruption.

Postoperatively the prostatectomy patient must be handled and watched over as carefully as any baby. The patient operated upon under sacral anesthesia may take fluids without becoming nauseated, not only immediately after operation, but during the operation as well.

After the operation is over he should be allowed to rest quitely in bed which he will do in almost 100 per cent of the cases, because he remains somewhat under

PROSTATIC OPERATIONS UNDER REGIONAL ANESTHESIA UP TO JANUARY 1, 1928
James Buchanan Brady Foundation for Urology

Diagnosis	No. of Cases	Average Age	Operation	Type of Anesthesia	Postoperative				Other Complications	Average Length of Postoperative Stay in Hospital	Results			Mortality (Per Cent)
					Good	Medium	Poor	Shock			Cures	Improved	Dead	
Ademonatous hypertrophy of prostate gland.	297	64.47	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	266	28	3	10	Hemorrhage 6	22.76 days	280		17	5.7
Carcinoma of the prostate.	33	67.36	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	23	7	3	None	None	21.5 days		30	3	10.0
Prostatic abscess.....	40	29.17	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	40	0	0	None	Epididymitis 2 cases Septicemia	10.83 days	40		0	0
Tuberculosis of the prostate gland.	2	61	Perineal prostatectomy	Sacral Parasacral procaine 1 per cent	2	0	0	None	None	27.5 days	1	1	0	0
Hodgkins disease of the prostate.	1	32	Suprapubic prostatectomy	Sacral Parasacral and suprapubic block	1			None	None	14 days		1		0

the influence of the narcotics and anesthesia for hours. He should only be disturbed to administer fluids and to take the blood pressure, which is the most important single test to make in such cases.

If the blood pressure drops unduly and does not rise (premonitory symptoms of shock) gum-glucose solution may be administered after the method described by us in 1921. Transfusion of properly tested blood may be administered in extreme cases. In case the bleeding has stopped, the packing is removed from the prostatic capsule in twenty-four hours, the tube is removed from the bladder on the third day and the patient permitted to sit up in a chair on the fourth day. Man is unquestionably an upright animal and apparently all bodily organs functionate better with the patient sitting in a chair than when he remains in bed. The patient receives a remarkable psychylogical boost when his feet touch the floor and one cannot help but be impressed by the fact that improvement is marked after he is allowed out of bed.

Upon revealing the results of operations upon the prostate one is forcibly impressed by the fact that age is no contraindication to operation whatever. In our series of cases there were 26 men over eighty years of age, of whom all except one lived for varying, considerable lengths of time after prostatectomy, and died of some other cause in no way connected with the operation.

Almost every case that recovers from a perineal prostatectomy is able to return to his customary duties. Provided both sphincters are not lacerated beyond repair there is never a resulting incontinence; apparently either sphincter may be totally obliterated, provided the other remains intact, without incontinence. Persistent fistula never results if the perineum is reconstructed by one stitch drawing the two parts of the levator ani together. Frequently patients whose prostates have been removed are able to enjoy sexual intercourse. Occasionally the ejaculated mass goes back into the bladder instead of being projected from the urethra.

The bladder, usually infected before operation, almost always afterwards will clear up under appropriate treatment provided the operation has been successful, and there is no residual urine.

Conclusion. In conclusion it is appropriate to state that the most important thing about an operation for the removal of an enlarged prostate is the preoperative preparation which is summed up in the one word "drainage." Next in importance is the choice of anesthetic. This should not be an inhalation anesthesia if it is possible to avoid it.

CARCINOMA OF THE PROSTATE

It will be seen by referring to the accompanying chart that there were 33 cases of carcinomatous prostate operated upon with a mortality rate of 10 per cent.

It is our practice to remove carcinomatous prostates which cause residual urine because even the most enthusiastic supporters of radium treatment admit that the application of radium has no beneficial effect on the relief of obstruction. Therefore we remove the prostate by the methods here described and as soon as the patient recovers from the immediate effects of the operation radium is administered to the prostatic bed in the form of emanation seeds or the element itself is applied. In our experience it is noted that there is little liability of the growth returning at the site of the prostate. The patients usually live from two and one-half to three and one-half years, ultimately dying of metastasis.

This method of treating carcinoma is well worth while as the patient does not die of uremia and does not undergo the distressful urinary symptoms which he otherwise would surely have.

PROSTATIC ABSCESSES

Our series shows 40 cases of prostatic abscess operated upon by the perineal route under regional anesthesia. In a study made some years ago when the author had the honor of serving on Dr. Keyes' staff at Bellevue, parallel series of cases were operated upon by the perineal and suprapubic route. It was found that the average stay in the hospital after transvesical prostatic drainage for abscess was 31 days, while by the perineal route the average postoperative stay was 16.9 days.

The average of our cases was 29.17 years. There were 2 cases of epididymitis and one case of septicemia following operation. The latter case recovered after repeated blood transfusions. The average postoperative stay was 10.83 days. None of these cases died.

TUBERCULOSIS OF THE PROSTATE

Two cases of tuberculosis of the prostate were operated upon. A mistake in diagnosis was made in each case. One aged fifty-three showed prostatic shadows in the *x*-ray and the palpating finger detected a grating. The provisional diagnosis was prostatic calculi. Operation revealed what was considered a calcified tuberculous abscess of the prostate. This diagnosis was confirmed by the pathologist.

The other patient, aged sixty-nine years, had a prostate three times the usual size which caused a residual of ℥vi. It was removed in the customary manner. The pathological report showed it to be "hypertrophia fibroadenomatosa prostates and caseous tuberculosis of the prostate gland."

These patients made uneventful recoveries.

CASE OF ENLARGEMENT OF THE PROSTATE GLAND SHOWING SOME OF THE CHARACTERISTICS OF HODGKIN'S DISEASE

Our case at the James Buchanan Brady Foundation for Urology of the New York Hospital presented a definite lymphocytosis, a moderate anemia of the chlorotic type, an enlargement of the chain of inguinal lymph nodes on each side, a loss of weight and strength and an impaired appetite and the general appearance of a tuberculous individual, all associated with marked enlargement of the prostate, acute

retention and urinary symptoms of only three months' duration.

The case presented the following history:

A single man, aged thirty-two years, was admitted to the Medical Division of Dr. W. R. Williams on December 7, 1926 and transferred to the Urological Division, December 11, 1926. He stated that his father died at the age of fifty-nine, from cancer of the liver. He was ill fifteen months. His mother died at the age of twenty-eight, from pulmonary tuberculosis. She was ill one and one-half years. He has one brother and two sisters, all living and well. He denies lues and gonorrhea by name and symptoms. He had mumps ten years ago. Pneumonia fourteen years ago. Until four years ago he was a chronic drinker. Since that time he has never touched liquor.

About three months before admission to the hospital he developed a moderate frequency of urination by day and by night. As time progressed this condition grew worse and was associated with painful and difficult urination. He noticed no pus or blood in his urine. His sexual powers were undisturbed. Three days before admission to the hospital he was unable to void except with utmost pain and difficulty. He finally developed acute retention and was brought to the hospital in an ambulance. His bladder was decompressed gradually by means of a retention catheter. He was fairly well nourished and seemed in moderately good health, although he stated that he had lost 20 pounds during the past six months and during the past three months he had grown progressively weaker, but had not been confined to his bed. He had no cough. His bowels moved regularly. His appetite was impaired. He did not suffer from insomnia but grew dyspneic on slight exertion.

His general physical examination was negative except for moderate bilateral enlargement of the inguinal lymph nodes and a small fibroma on the inner aspect of the left thigh. His liver and spleen were not palpable. Chest negative. The lower poles of both kidneys could be felt as well as the distended bladder. Rectal examination revealed slight hemorrhoids. The sphincter tone was good, the prostate was about twice the usual size, it was hard on the right side but did not have the boardlike rigidity of carcinoma. The left side of the prostate seemed normal in consistency and not fixed in position by adhesions. The left seminal vesicle was palpable but not enlarged. The right was barely palpable. The impression gained at that time was hat the patient was suffering from enlargement of the prostate with retention of urine.

Cystoscopy under caudal anesthesia revealed a diffusely reddened vesical fundus. Ureteral orifices were not distinctly seen. The vesical orifice was most interesting in that it showed a tremendous intrusion of the subcervical group on its floor.

Blood urea nitrogen 17 mg. per 100 c.c. Blood sugar 0.112 per cent. Carbon-dioxide combining power of the blood plasm 56 volumes per cent. The phenolsulphonephthalein test showed a secretion of 60 per cent in two hours at one examination and 75 per cent at another.

Blood Wassermann reaction was negative with both antigens on two occasions. Cultures from bladder urine showed B. coli communis and Staphlococcus albus.

Urine examination: Reaction acid, Specific gravity 1018. Trace of albumin, no sugar, no acetone.

Microscopic examination showed many red blood cells, few white blood cells, occasional epithelial cells, no crystals, no casts.

Complete blood was made on two occasions as follows:

	December 8, 1926	January 9, 1927
Red cells	5,112,000	4,815,000
Hemoglobin, per cent	93	88
Color index	0.91	0.92
White cells	8,600	7,400
Polynuclear neutrophiles, per cent	54	46
Lymphocytes, per cent	38	44
Large non-nuclear, per cent (Transitionals)	6	7
Eosinophiles, per cent	2	3

Blood pressure on entrance: 114 systolic, 62 diastolic.

X-rays of the genitourinary tract revealed both kidney shadows large in size and low in position. There was no shadow indicative of stone in the urinary tract.

The patient was subjected to a suprapubic cystosomy under local anesthesia. Examination of the interior of the bladder revealed a mass extending from the floor of the bladder neck about the size of a walnut which was rather firm in consistency. A specimen was taken from this tumor-like projection and sent to the laboratory for examination. The bladder

was drained by suprapubic suction for a period of fourteen days, after which time the prostate was removed suprapubically under sacral and parasacral anesthesia. It was interesting to note that this growth had greatly increased in size since the first operation. The site whence the original specimen had been removed had grown out in a very irregular manner so that it represented a cauliflower. Malignancy was suspected. The prostate was removed completely except for one point on the left lateral aspect where it was densely adherent and apparently infiltrated into the capsule of the prostate. The patient made an uneventful recovery and was discharged from the hospital fourteen days after prostatectomy with good urinary control and wound completely healed.

The prostate was examined by Doctors Elser and Semsroth of the New York Hospital. The report is as follows:

The specimen consists of several irregular shaped pieces of tough tissue measuring from 1 to about 4 cm. in diameter. The outer surface appears yellowish white, somewhat translucent, opaque yellowish strands are seen running through a whitish matrix. The gross picture is not that of a carcinoma nor does it show evidence of a normal prostatic tissue.

The accompanying microscopic slide shows the picture of a chronic inflammatory process. The granulomatous new-formed tissue is rich in plasm cells and contains mononuclear giant cells of the Sternberg type.

The condition is inflammatory (a granuloma). Plasma cells and Sternberg giant cells point to Hodgkin's disease. The latter malignant lymphogranulomatosis starts in lymphoid structures and as a rule spreads to other lymphoid structures, leading to a general lymph node enlargement, always fatal. The localization, however, of the process at the neck of the bladder is most unusual in Hodkgin's disease.

An inguinal lymph node was removed and examined. Microscopic sections showed simple chronic lymphadenitis with no evidence of a granulomatous process like that seen in Hodgkin's lymphogranulomatosis.

The small tumor on the inner aspect of the left thigh showed on microscopic sections the picture of a fibroma durum covered by stratified squamous epithelium.

Summary of Findings. It is unusual to find complete retention of urine in a man aged thirty-two years due to a solid tumefaction of the prostate gland.

The gradual onset of the symptoms exhibited by the patient is similar to those described by most of adenomatous enlargements of the prostate in old men. The usual frequent and painful urination culminated in complete retention of urine rather more rapidly than most cases of adenoma.

There was a rapid increase in the size of the intrusion in the two weeks' interval between the suprapubic cystosomy, at which time a piece of tissue was removed from the tumor for diagnosis, and the actual removal of the mass with the prostate. The spot whence the specimen was removed showed a cauliflower overgrowth such as one sees in almost any malignant growth under similar conditions.

Upon removal it was noticed that it enucleated quite freely except at one point on the left lateral aspect where it was densely adherent and had apparently infiltrated into the capsule of the prostate. The impression of the author at the time of operation was that the case was one of malignancy of the prostate.

The specimens removed when examined microscopically showed granulamatous new-formed tissue rich in plasma cells containing mononuclear giant cells of the Sternberg type.

The examination of the enlarged inguinal lymph nodes showed simple chronic lymphadenitis with no evidence of a granulomatous process like that seen in Hodgkin's lymphogranulomatosis.

CONCLUSIONS

It is concluded from observations of a large series of cases (373) that:

1. The most important item in the care of a case suffering from prostatic disease is a suitable drainage until the patient reaches his maximum of renal efficiency.

2. The author believes that the best kind of preliminary drainage is by means of suprapubic double tube suction, because such a procedure diminishes the

edema of the prostate and thus is a factor in reducing bleeding.

3. Sacral or parasacral is the most suitable type of anesthesia for prostatectomy. Its advantages are:

a. It is efficient.

b. It allows the patient to take fluids up to, during and immediately after operation.

c. The bleeding is very much less than it is with any kind of general anesthesia.

d. Anesthesia persists for several hours after operation making the administration of morphine with its attendant bowel stasis unnecessary in many instances.

4. Perineal prostatectomy is preferred because there does not seem to be so much shock as noted in the suprapubic operation. The postoperative drainage is accomplished by means of an urethral catheter which allows both the perineal and suprapubic wounds to close.

5. The average postoperative stay in the hospital has been reduced to 22.76 days.

6. Almost 10 per cent of the prostates operated upon were carcinomatous.

7. The mortality for the adenomatous cases was 5.7 per cent while there were 3 deaths out of 33 cases of carcinoma.

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DISCUSSION

Dr. John Morrissey: Dr. Lowsley's enthusiastic and very interesting presentation of of the principles which he has advocated for the past six year is very impressive but the fact that it is not entirely convincing and fully accepted is borne out by the very limited number of perineal prostatectomies which are being done in the hospitals of New York City. Some three years ago I attempted to make a tabulation in this regard and less than 30 cases were discovered in a total of 14 hospitals during the preceding twelve months. It would seem, therefore, that his principles, those of Dr. Young and other forceful advocates of the perineal route, do not fully obtain and for that reason, therefore, my own experience in this regard may not be altogether uninteresting.

In the past six and one-half years I have operated on some 275 cases of enlarged prostates and some 200 of these have been perineal operations. I must say that the greatest objection to the perineal route is the dribbling, lack of control incontinence that follows the operation. Dr. Young and others consistently deny that incontinence or any interference with control is a complication of a perineal procedure and yet you can meet any number of urologists who have seen numerous cases of disturbed control following perineal prostatectomy. The very fact that numerous modifications of the original Young operation have been devised to meet this complication would seem sufficient evidence that we have a definite problem to deal with. As a matter of fact, I have devised an operation myself which attempts to preserve the external sphincter, thereby overcoming this difficulty.

My feeling regarding dribbling is that it concerns solely the mechanics of the bladder in that in enlargement of the prostate you have a dilatation of the internal sphincter. This is generally functionless, and in the perineal operation it is practically impossible to avoid damaging the external sphincter. Often times this damage is not done until the prostate is pulled out from its bed when some fibers of the sphincter are torn. The tear may be only microscopic and yet it is sufficient to interfere with adequate control, particularly in the presence of a useless internal sphincter. After the wound is healed, even though the sphincter be torn, there are scars formed which provide a certain amount of tension and assistance in enabling the patient to retain his urine. As this scar is gradually absorbed, however, the sphincter relaxes and in two years it may be fully determined whether or not the patient has or has not control which is satisfactory to him.

The urologists at Mayo Clinic point with certainty to numerous cases where this dribbling has not been observed until after the two-year period. It is my practice to thoroughly drain the prostatic bed and space inside the levators not only with a gauze drain but with rubber tubes and this is kept up for some ten days following the removal of the packing. This prevents a scar formation and you are able early in the convalescence to train the patient in developing control in the event that it is lacking at first. In my operation the prostate is removed around the urethra and in the capsule incisions they are carried to either side of the center rather than into the urethra themselves. There are numerous other outstanding features of perineal prostatectomy which are unparalleled in the consideration of the advisability of methods. First, as regards bleeding. It is a complication never met with. I have operated on some 125 cases where it has not been required to tie a single vessel. I avoid cutting the levator muscles, lifting them from the prostatic capsule, and in placing a deep suture through these muscles to close the wound you practically control the entire amount of bleeding met with. A further point might be made with regard to the safety of this method in patients over seventy-five years of age. I recently operated on a man eighty-nine years of age. As a matter of fact, he left the hospital today, exactly two weeks after his prostate had been removed.

As regards mortality. I do not feel there is a great degree of this. I simply insist that I feel much more certain as to the outcome in the perineal cases. You must take my word as to the ease of dressings and postoperative care following perineal prostatectomy compared with suprapubic prostatectomy. Here the judgment of one who has done an equal number of both must be accepted. It is interesting to note also the relative seriousness of complications. For example, a epididymitis after a perineal prostatectomy is generally much less severe than one following suprapubic prostatectomy. Let me bespeak a more earnest consideration of some of the advantages that this perineal prostatectomy offers and

I am sure if the procedure is utilized more frequently you will be amazed at the satisfactory results which will be obtained.

Dr. Howard Jeck: I happen to belong to the majority who favor the suprapubic method, but I agree with Dr. Lowsley in two of the points that he brought out namely, the advantages to be derived from decompression in those cases with a large amount of residual urine and the suprapubic method of preliminary drainage. I do not think the suprapubic route can be improved upon as far as preliminary drainage is concerned.

As for the control of hemorrhage, in my experience I cannot recall a case where the hemorrhage has not been satisfactorily controlled by the Pilcher bag. I have seen operators tie off bleeding vessels as Dr. Lowsley has described and think it is a beautiful procedure, yet I cannot but feel that, from my experience, it is quite unnecessary. In most instances the hemorrhage is not alarming and where it appears so it is satisfactorily controlled by the Pilcher bag.

I should like to ask a couple of questions. In the first place, has Dr. Lowsley encountered many cases of hypertrophy of the trigone with a bas fond behind the interureteric ridge, and if so, how does he handle the situation? Secondly, how many cases of incontinence has he seen after the perineal operation?

Dr. Meredith Campbell: I would like to ask a question about the method of decompression employed, that is the emptying of the bladder and partial refilling. I would like to know if these patients have shown any evidence of renal shock following this procedure. At Bellevue Hospital some ten years ago we made observations in a series of 25 cases admitted in acute retention because of prostatic hypertrophy. In these cases the bladder was emptied ounce by ounce, the bladder pressure being taken with the withdrawal of each ounce. I found that in all cases when 4 ounces had been withdrawn the bladder pressure was reduced 50 per cent. In some instances with the withdrawal of but 2 ounces the bladder pressure was reduced one-half. We felt that this represented the major portion of the cause of the renal shock associated with rapid decompression or evacuation. I wish to know if withdrawing all the urine and refilling with one-half the original amount is succeeded by any evidence of renal failure clinically.

Dr. Lowsley, *closing:* Dr. Morrissey spoke about the scar tissue surrounding the healed operation. That is very important. I did not say much about the postoperative treatment, but I think that every patient operated on should have a regular course of dilatation following it. We have here a circular wound, and all circular scar tissue will contract. I have seen a case who had not been dilated, who, in one year's time after his operation had a contraction to a pin point size of his vesical orifice, because he did not follow the advice which must have been given him to have himself dilated after operation. One year later he was passing practically all his urine through his suprapubic fistula, which had never healed. He was cured by an external urethrotomy and dilatation of the vesical orifice, because we could not enter the urethra:

Dr. Jeck asked about the formation of a bar (hypertrophied trigone). I have seen two or three cases of that sort, and practiced the procedure laid down by Hinman. I had one case recover with very excellent results. I excised the interureteric ridge and also cut Bell's muscle at the edge of the trigonum vesicae.

Incontinence: While practicing the old procedure that Young devised and which lasted for fifteen years without any modification (then six or seven modifications were made in two years) we used to have 10 per cent of cases with incontinence for long periods of time. We found that it was due to the injury of both sphincters; that is why we make such a point of not interfering with the structures around the external sphincter; we try to leave it undamaged. Since adopting this method we have had only one case of persistent incontinence which has caused the man all sorts of trouble. That is the only case I know of. We have had several patients who have had some relaxation, would lose a drop or two when they cough or sneeze . . . but the average case will have control in two weeks to two months.

Replying to Dr. Campbell's remarks about decompression: I do not think we have had a single patient develop uremia due to our method of decompression. The method used by Hamer, to put a reservoir of fluid at a certain height above the bladder and then lower it a little each day, is a very good method too; but as far as I know we have not put any one into uremia by this very simple device of putting back half of the amount of fluid and allowing the badder to fill up.

POSTOPERATIVE PHYSIOLOGICAL STUDIES IN A CASE OF TRAUMATIC RUPTURE OF THE LIVER WITH RECOVERY*

R. B. McKNIGHT, M.D., F.A.C.S.

CHARLOTTE, N. C.

THE liver is probably the most frequently injured viscus in the abdomen in abdominal injuries. Owing to its friable nature, size and anatomical position, concussion may cause a lesion of varying degrees of severity, slight and inconsequential or extremely grave. Sudden blows over the abdominal wall, particularly if they involve much surface, are prone to cause injury to this organ.[7] It has a distinct tendency to split or crack in a more or less stellate manner, with massive hemorrhage and escape of bile.[8] When Glisson's capsule is badly lacerated, the amount of hemorrhage is necessarily greater than when the trauma is limited chiefly to the liver parenchyma.[4] Frequently other abdominal or thoracic organs or the diaphragm are injured also, thus producing more or less serious complications which may mask symptoms referable to an injured liver.

The causes of traumatic rupture are, of course, varied; gunshot wounds, stabs with sharp instruments and crushing injuries with or without a break in the skin. Stabs and gunshot wounds usually recover following immediate operation, provided there is not too much destruction of tissue. Rupture due to sharp concussion causes a much higher mortality. Ashhurst, quoting Boljarski, places the mortality after operation at 75 to 80 per cent.[1]

The symptoms of subcutaneous traumatic rupture of the liver are well outlined by Graham, who reported 11 cases, one his own.[6] There are several points I wish to lay some stress upon, however. (1) Intermittent severe pain radiating in various directions, depending on the site of the rupture. If the convex portion of the right lobe is injured, pain is referred to the right scapular region as in cholecystic disease; if the concave portion is involved the pain is referred to the waist line anteriorly. Steiger[11] states: "A symptom usually present is pain radiating into the right shoulder as is commonly noticed in gall-bladder disease. This is real assistance in diagnosis of hepatic injury." (2) Shock is usually present, although various observers have reported it at times almost absent. (3) Many have noticed a slow pulse. Erderly[5] operated on a fatal case of liver rupture in a boy thirteen years of age with a perfectly healthy heart, who had a pulse rate of 60 in spite of severe intra-abdominal hemorrhage. He concluded that bradycardia cannot be considered evidence against intra-abdominal hemorrhage when other symptoms speak for it. Indeed, some surgeons have considered a slow pulse as indicative of liver injury. Orth[9] reported a case in a twenty-seven year old man who had a pulse rate of 54 two hours after the accident. He stressed the fact that marked tension of the abdominal wall and bradycardia were the foremost symptoms in the pathological picture. Experimentally he was able to produce bradycardia in dogs after hepatic injury, but only when there was a profuse discharge of blood and bile into the free peritoneal cavity. (4) Board-like hardness and exquisite tenderness occur over the involved area as a rule. (5) There is a sharp rise in the leucocyte count, whereas the erythrocyte count and hemoglobin may be slower in dropping. (6) In severe injury jaundice seldom appears before the third or fourth day, and it may not appear at all.

Treatment consists in early operation, utilizing whatever methods are deemed

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best on sound surgical judgment to control bleeding in the individual case. Transfusions are, of course, indicated, and probably the earlier begun the better. White[12] suggests autotransfusion of blood in the peritoneal cavity when it cannot be obtained from other sources. He has reported such a case with recovery. As an emergency procedure this is justifiable. However, the presence of extravasated bile and the possibility of the contents of a ruptured hollow viscus mixed with the blood in the abdominal cavity, should make this a procedure to be done only after very careful abdominal exploration. Various supportive measures and careful postoperative observations both clinical and laboratory, with prompt attention to whatever complication may arise, are necessary.

Prognosis seems to depend largely on several factors: (1) the amount of destruction of liver tissue; (2) the escape of bile into the peritoneal cavity, which is quite liable to be a contributing cause to a paralytic ileus; (3) the presence or absence of injury to structures other than the liver, and (4) careful attention to any postoperative complications which might arise. It is well to remember that Mann of the Mayo Clinic has found life incompatible with a minute amount of liver tissue left free in the abdomen.

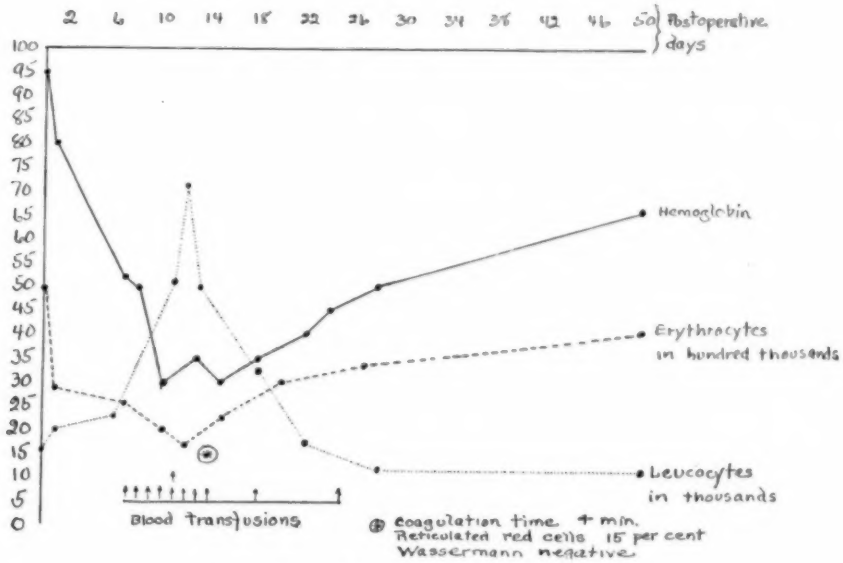

Fig. 1. Hemoglobin, red cells and white cells.

CASE REPORT

A young white man, aged nineteen, was injured in an automobile accident about 8:30 the evening of April 29, 1928. He was sitting in the rumble seat of a car which collided head-on with an on-coming car, throwing him with violent force against the back of the seat in front. He struck his right chest and right upper abdomen and at once experienced severe pain in these areas. I saw him in about half an hour after the accident at the Mercy General Hospital. His pulse was 74, temperature 98.4°F. and respirations 26. He complained of pain in three distinct locations: (1) the upper right abdominal quadrant; (2) the right chest wall, and (3) the right scapular region. Examination revealed a well-developed young man in moderate shock. There was an area in the upper right abdominal quadrant board-like in hardness and exquisitely tender, a spot in the right anterior axillary line about the seventh or eighth rib was quite painful on palpation and there was a slight laceration of the face which was of no consequence. Urinalysis was entirely negative. The blood count showed a hemoglobin of 90 per cent, 5 million red cells, and 16,000 white cells. Roentgen ray of the chest revealed a fracture of the seventh rib

in the anterior right axillary line with perfect approximation of the ends. Two per cent mercurochrome was applied to the laceration

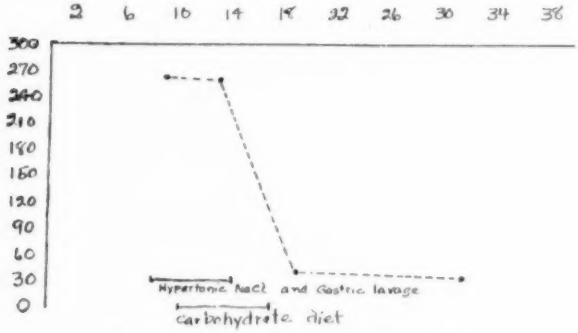

Fig. 2. Blood urea (in milligrams).

on the face; the chest strapped with adhesive and a period of "watchful waiting" assumed in so far as the abdominal condition was concerned. Mild opium narcosis and a hot water bottle to the abdomen were ordered. During the night the pulse went down to 54 (three hours after the accident) and the patient was restless and in pain. At 11:30 P.M. the white count had risen from 16,000 to 20,000

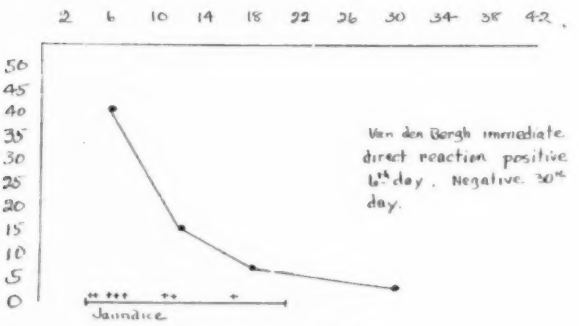

Fig. 3. Icterus index.

The following morning the pulse was 70, temperature 98.4°F. and respirations about 20. Blood pressure was 120/74. The urine showed a faint trace of albumin and was positive for sugar. The white count was still 20,000. Abdominal pain and board-like hardness were more pronounced. I could not make out a fluid wave. About noon the pain became unbearable. I made a tenative diagnosis of ruptured liver 75 per cent, ruptured hollow viscus 15 per cent and ruptured spleen 10 per cent. Before operating, however, I desired consultation in view of what I considered atypical symptoms. The consultant concurred in my diagnosis.

Exploration was performed at 2:30 P.M. April 30, under morphine narcosis and light ether anesthesia. A high right rectus incision

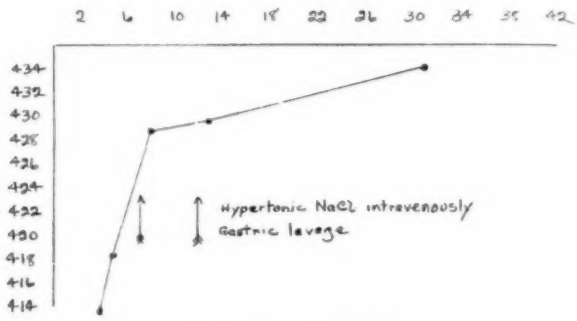

Fig. 4. Blood chlorides.

was made; there was approximately 1000 c.c. of blood, both fresh and clotted, in the abdominal cavity, this was removed with sponges and the aspirator as thoroughly as possible; the intestines were markedly bile stained; the gall bladder was completely collapsed, but no injury to that viscus or the ducts could be found; the spleen, stomach, duodenum, intestines, pancreas and kidneys were negative for injury; blood was seen trickling down the

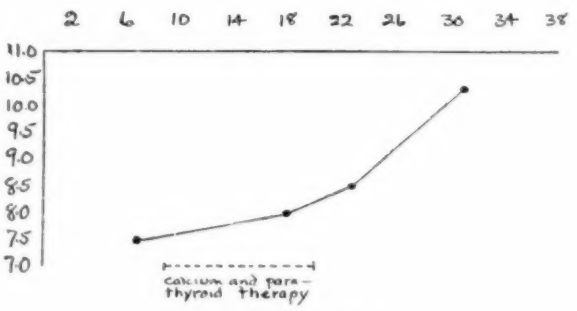

Fig. 5. Blood calcium.

anterior surface of the liver, but no rupture was visible; the exploring hand encountered a large rent far up on the superior surface of the dome of the right lobe of the liver; this rupture easily admitted four fingers, which went down into liver tissue against no resistance as far as they could be thrust in a bent exploring position; there was no injury to the diaphragm. Suturing of this wound was absolutely out of the question. The cavity and area between the dome and the diaphragm were packed with about 16 feet of uterine packing which was brought out of the upper pole of the abdominal incision through a Penrose drain. I made a rapid closure completing the operation in about thirty minutes.

The patient left the operating table in fair condition only. The usual immediate postoperative supportive measures were instituted.

Postoperative Course. Reaction from the operation was uneventful. For five or six days his condition remained satisfactory. On the sixth day his condition became worse; jaundice was markedly increased, the abdomen was somewhat distended, and nausea, which heretofore had been about what one would expect following an ether anesthetization, was more pronounced. The patient looked toxic. For eight days he remained in a critical condition, with symptoms characteristic of a severe toxemia of obstructive origin. At the end of the third postoperative week he was well on his way to recovery.

During the critical stage the observations charted below were made, and treatment was based on their findings as well as on clinical observations. This treatment consisted of daily blood transfusions, hypertonic intravenous saline infusions, gastric lavage, practically a pure carbohydrate diet (inclusive of glucose by rectal drip), calcium and parathyroid therapy and supportive cardiac measures.

CLINICAL OBSERVATIONS

1. *Pulse, Temperature and Respirations.* The pulse dropped to the low reading of 54 in about three hours after the accident in spite of severe intra-abdominal hemorrhage. The highest it went before operation was 80, and then immediately before surgical intervention. The temperature and respirations were about what would be expected throughout his illness, with the exception of the twelfth postoperative day when a subnormal temperature, labored respirations and a mounting pulse rate led me to expect an early death.

2. *Blood Picture.* The hemoglobin dropped to 80 per cent on the day of operation. Six days subsequently it was 52 per cent. Blood transfusions were begun and were given daily, two on the eleventh postoperative day. In spite of nine consecutive transfusions of 500 c.c. each of citrated blood, the hemoglobin dropped steadily to 30 per cent. The red cells dropped accordingly to 1,600,000 while the leucocytes went up to 72,000 with neutrophiles over 80 per cent. The fourteenth postoperative day the coagulation time was four minutes and there were 15 per cent of reticulocytes with the red count and hemoglobin at their lowest levels. At no time was there any appreciable amount of fresh blood on the dressings.

3. *Blood Chemistry.* (a) The blood urea on the eighth postoperative day was 268 mg. per 100 c.c. of blood. Under gastric lavage, hypertonic intravenous saline injections and carbohydrate feedings it dropped to 32 mg. per 100 c.c. in about ten days.

(b) The blood chlorides on the fifth day were 418 mg. per 100 c.c. In a week's time under therapeutic measures outlined it had risen to 430 mg. per 100 c.c.

(c) The blood calcium under calcium and parathyroid therapy rose slowly from 7.5 mg. on the seventh day to 8.5 mg. on the twenty-third day, and finally to 10.4 mg. on the thirtieth day.

(d) The icterus index was 42 the sixth day. With the disappearance of jaundice on about the twenty-second day it had dropped to 5.0. The Van den Burgh test showed an immediate positive direct reaction which became negative in about a month.

4. *Urine.* The urine was entirely normal on admission. The day of operation it showed a trace of sugar and a faint trace the third day. Albumin and granular and hyaline casts promptly appeared and remained fairly constant for three weeks. On dismissal from the hospital, there was a very faint trace of albumin and a rare cast in centrifugalized specimens. Determination of acetone bodies was not done, it is improbable that they were present.

DISCUSSION

The physiological significance of the liver assumes great proportions when we realize that it is located between the intestines and the greater circulation. It is difficult to grasp the complicated functions of this important structure. The researches of Mann and his co-workers at the Mayo Clinic have thrown considerable light on its intricate processes.

It is not probable that the high blood urea is evidence of hepatic insufficiency. Taken with the clinical picture and the low blood chlorides it is undoubtedly evidence of gastrointestinal stasis. The cause of this stasis is undoubtedly twofold: first, the trauma in the peritoneal cavity, and, second, the leakage of bile in the

peritoneal cavity was probably sufficient to produce a paralytic ileus.[2] This was overcome by the injection of hypertonic sodium chloride solution and gastric lavage. With the recovery from the condition, as evidenced by renewal of intestinal activity, the blood urea dropped to normal.

The institution of a carbohydrate diet is of direct value in cases of liver injury, although the exact mechanism involved is a matter of speculation at the present time. Bollmann[3] has found that animals with a greatly damaged liver recover much better on a carbohydrate diet than on diets containing proteins.

The appearance and degree of jaundice was checked with the laboratory observations on the bilirubin content of the blood. The behavior of these tests and the picture of clinical icterus was that of a mild obstructive type of jaundice. The gallbladder was found to be completely collapsed at operation and much bile was being poured out of the wounded liver. This presented a situation somewhat comparable to a case of obstruction. Blood was being destroyed and accordingly the bile was becoming thicker and richer in pigments so that the ducts could not be readily emptied by the secretory pressure of the liver. The secretory pressure of the liver was necessarily decreased due to the shattering of the right lobe and rupture of Glisson's capsule. Consequently bile was dammed back and forced into the lymphatic channels with a resulting icterus.

An interesting feature is the rapid fall in hemoglobin and red cells in spite of nine blood transfusions, the practical absence of any fresh blood on the dressings and the presence of 15 per cent reticulated red cells. The explanation is closely linked with that of the icterus just discussed. Obviously it was a hemolytic sort of an affair, toxic in origin, a hemohepatogenous jaundice. This is usually referred to as a non-obstructive jaundice, which in reality is not a non-obstructive jaundice at all. There is an obstruction which is shifted from the larger ducts to the small bile radicles. Many, of course, escape, so that there is not a complete obstruction but a partial one.

The cumulation of urea in the blood may have been associated with renal impairment. Kidney disfunction might have been partially due to trauma, gastrointestinal stasis, jaundice, and also to the destruction of blood both from hemorrhage and from that given in transfusions. As the symptoms of toxemia developed, naturally the kidney showed symptoms of damage: heavy traces of albumin and the presence of numerous casts. It is probable that there was no acidosis as evidenced by the low blood chlorides, high urea and the probability of a high CO_2 combining power. Later the carbohydrate diet would preclude the possibility of an acidosis. The presence of sugar on two occasions early after operation was probably due to shock associated with the accident and the operation. It promptly disappeared.

By the end of the third postoperative week all clinical findings were either normal or rapidly approaching normal. In four months he was back at work, practically recovered from the accident and complications subsequent thereto.

It is interesting to note here that a year subsequently I referred him to Dr. H. C. Shirley of Charlotte for advice as to tonsillectomy. This was performed by him under local anesthesia. Three days after the operation the patient developed a generalized ooze of blood from each fossa, which persisted in spite of entirely normal blood chemistry findings, normal blood coagulation time, normal platelet count and the usual therapeutic measures, until a small blood transfusion was given.[10]

SUMMARY AND CONCLUSIONS

The case reported is an excellent one for study in that the only primary lesion of any consequence was that of subcutaneous rupture of the liver. The outstanding clinical features of the case were: (1) board-like hardness in the upper right abdominal quadrant; (2) referred

pain to the right scapular region, and (3) a slow pulse reaching the low count of 54 three hours after the accident in spite of severe intra-abdominal hemorrhage.

Probably the high mortality in crushing injuries of the abdomen, especially those cases in which the liver is ruptured, is influenced to a large extent by the development of a gastrointestinal stasis and resulting toxemia. This stasis may occur as a result of trauma in the peritoneal cavity, or to a leakage of bile into the peritoneal cavity sufficient to produce a paralytic ileus. The case reported and the studies thereon tend to support this idea.

In addition to early diagnosis and proper surgical means for controlling hemorrhage, it is essential that complications subsequent to and depending on a gastrointestinal stasis should be anticipated and promptly handled. The use of carbohydrate feeding, hypertonic saline intravenously and gastric lavage is stressed. The attempt on the part of the body to regenerate blood should be assisted by repeated blood transfusions. Observations on the blood chemistry are necessary for proper treatment.

It is well known that the use of spinal anesthesia is very efficacious in the treatment of paralytic ileus; perhaps such an anesthetic would be the anesthetic of choice in these injuries as a possible prophylactic measure.

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THE LATENT GALL BLADDER*

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FOR the purposes of this paper the latent gall bladder is considered to be the one whose function is impaired or lost, as distinguished from frank gall-bladder disease easily diagnosed, although it will be necessary to make some reference to the latter. Probably 10 per cent of the adult population have more or less disease of the biliary tract and due to the factor of pregnancy 8 out of 10 of them are women. This especially applies after the age of forty. There are thousands of people today, who in the next ten or twenty years will go to the operating table for the purposes of having a diseased gall bladder removed. Following operation many will die, probably 5 per cent according to the present average statistics.

While little can be said for the tonsils and appendix, something can be said for the gall bladder. It is now definitely known that the gall bladder concentrates the bile to about one-tenth of the amount delivered from the liver. This bile is passed on to the duodenum at the proper time during digestion. The gall bladder also regulates the pressure in the ducts and may have something to do with fat digestion. However, it is well known that one can get along without it, in fact with great improvement in health if it is removed following proper indications. Following cholecystectomy the ducts dilate, the sphincter of Oddi relaxes and digestion seems to go on as well as when the gall bladder was functioning normally. However, the functional importance of this organ compared with its great power for evil is insignificant, indeed. Acute and chronic infection with or without stones, perforation with infection of the ducts, pancreas and liver and occasionally cancer, not to mention it as a source of focal infection in myocarditis, anthritis and other diseases, all of these can be caused by disease of this organ. It is also the most prolific source of indigestion and dyspepsia in the middle-aged adult. The older the individual when operation becomes necessary the greater the risk and the more widespread the infection, oftentimes resulting in only partial relief from cholecystectomy.

It has been aptly said that the stomach is the loud speaker for almost every organ of the abdomen. This is especially true for the non-functioning or poorly functioning gall bladder. The symptoms are essentially dyspepsia during early digestion, during the period when the stomach is mechanically reducing its contents to chyme and the duodenum is emulsifying the material received with the aid of the rapidly discharged concentrated bile. If the proper amount is not received there is abnormal activity in the duodenum with antiperistalsis and pylorospasm. This is clinically manifested by uncomfortable fullness after meals, belching and sour regurgations. Occasionally there is pain radiating around to the back. The patient finds that he cannot digest greasy, heavy, acid foods and for relief finds it necessary to exclude many varieties of food to which he has been accustomed. These symptoms will most often occur when meals are large, or much rich, sweet food is taken rapidly, or if the diet includes raw fruits, salads and especially fats. Sometimes they follow unusual nervous fatigue. Another type of individual in whom the gall bladder is at fault but often not suspected is the one with few complaints referred directly to the abdomen but many nervous symptoms and much complaint as to head pains. Diagnosis is difficult and mistakes are apt to occur if all other possible causes are not ruled out in this type.

The woman who has borne children and is now approaching middle age should always be questioned as to pain in the gall-

* Read before the Los Angeles Surgical Society, March 8, 1929.

bladder region during the latter months of her pregnancies or shortly after. Often infection starts at this time to remain latent for years afterwards until suddenly an acute cholecystitis develops or a typical gallstone colic occurs. Go into any woman's surgical ward in this country and you will find that almost every obese woman in that ward, barring an occasional umbilical hernia or other type of operation, represents a result of gall-bladder infection. She is there for a gall-bladder operation or for the repair of a hernia as the result of one. Incidentally, if we would look over our postoperative results we would find that postoperative hernia or weakened abdominal wall occurs more than occasionally. Obesity goes hand in hand with gall-bladder infections which have usually been latent for years. The infection flares up when the woman is excessively fat, a difficult subject to operate upon and often not a first-class surgical risk.

In the overweight, middle-aged woman coming in with vague digestive complaints do not forget the latent gall bladder. Only yesterday I operated upon one of these patients, forty-nine years old, mother of ten children, and 70 pounds overweight. The history included many years of obscure digestive complaints variously treated as indigestion and dyspepsia. By standing on a stool so as to get into proper position I was able to remove a chronically inflamed gall bladder completely filled with large stones.

Up until four or five years ago the diagnosis of gall-bladder disease depended upon an accurate clinical history and careful physical examination supplemented by positive *x*-ray findings in possibly 30 per cent of the cases. A high average of correct diagnoses was made in the fairly typical cases as proved by operation. Now, due to the work of Graham and Cole, a new *x*-ray technic has been developed so that a positive diagnosis of impaired gall-bladder function is possible in the hands of an expert in about 90 per cent of the cases. It must be remembered that this test is a functional one and does not demonstrate pathology except in a minority of cases, as when gallstone shadows appear. I believe that this is the most remarkable advance in laboratory diagnosis in recent years. This new method has stimulated increased interest in the diagnosis of gall-bladder disease. Failing to fill is by far the most important sign. This is due to the occlusion of the cystic duct or complete lack of function. This, added to a clear-cut clinical history, makes the diagnosis certain in the majority of cases. Other important signs that may be of value are filling defects due to calculi or irregularities of contour due to pericystic adhesions. Interpretations of variations from normal in filling and emptying time give the most errors in the positive films, probably 5 per cent. The negative cholecystogram at present gives about 30 per cent of errors and should be disregarded if the clinical symptoms point definitely to disease of the biliary tract. However, with ill-defined symptoms and a negative *x*-ray report, surgery should be withheld until all other causes can be eliminated.

What is to be done about the quiescent or latent gall bladder? Should we rush all of these patients to the operating room as soon as we have determined that the gall bladder is not functioning properly, remembering a 5 per cent mortality and a morbidity which includes postoperative adhesions, ventral hernia and occasional injury to the common duct. Moynihan condemns, every gall bladder to excision if, in the presence of inaugural symptoms, the cystographic shadow is absent, its opacity diminished or its appearance delayed. It must be remembered that the more positive the symptoms the better the operative results, especially if pain is a predominant factor. The converse is also true. I believe that the case diagnosed early before the onset of typical symptoms should first be given the benefit of proper medical treatment.

I would like to say a word as to diet: This should be fat free; all meat fats,

cream, butter, oils, yolks of eggs and cheese are omitted or reduced to a minimum. Coarse vegetables are to be avoided or thoroughly cooked and pureed to reduce motor activity. Raw fruits are also excluded from the diet and the caloric intake is cut down to reduce obesity. This reduces the cholesterol content of the bile and the motor demands on the gall bladder are lessened, tending to a condition of physiological rest, during which inflammation subsides. In the early cases this may be all that is required but too much reliance must not be placed on this method. One or more recurrences will generally indicate surgery.

Besides the usual indications for gall-bladder surgery such as repeated gallstone colics, acute cholecystitis (always surgical when the attack has quited down), cholangitis and common-duct obstructions, the positive indications for surgery should include symptoms such as nausea, gaseous eructations, abdominal distention, headache and indefinite upper abdominal pain if other causes can be ruled out and thorough medical treatment has failed to bring relief. This especially applies to the overweight middle-aged patient. This should be confirmed if possible by positive *x*-ray evidence especially failure of the gall bladder to fill or demonstration of the presence of stones. In chronic myocarditis or arthritis when all other sources of focal infection have been eliminated, the removal of a latent, infected gall bladder may bring marked improvement.

Before closing may I briefly consider the contraindications to gall-bladder surgery even in the presence of definite pathology? In general they include severe myocarditis, decompensated cardiorenal disease, advanced nephritis, often diabetes and the severe anemias. Avoid surgery in the elderly patient with angina pectoris, the anginal attacks radiating to the ensiform. Mistakes are liable if the *x*-ray evidence is positive or a so-called silent stone is revealed. In differential diagnosis remember the relations of pain to exertion and the improvement with rest. Some time ago I was called in consultation on a case of this type, the date for operation already having been set. To avoid embarrassment I suggested calling in a heart specialist to see if the patient could stand operation. The operation was postponed and within a month the patient, while up and about, suddenly dropped dead.

In closing I would like to mention one more type of patient with latent or active gall-bladder disease in whom operation while not contraindicated is exceedingly dangerous. This is the fleshy individual with short neck and short abdominal walls. This patient has a flabby heart and a gall bladder situated deep under the costal arch. People of this type take anesthetics badly and they are subject to shock, postoperative pneumonia and nephritis. When operation is done, local anesthesia with the addition of nitrous oxide or ethylene is the anesthetic of choice.

INJECTION TREATMENT OF VARICOSE VEINS*

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UNTIL recently, the treatment of varicose veins of the lower extremities has been notoriously unsatisfactory. Surgical removal necessitates hospital confinement, requires a more or less prolonged stay in bed, and is not without its dangers. In addition to all this, unsightly scars often result and recurrences are far from infrequent. Under these circumstances, many surgeons do not urge operation, and many patients, unless positively disabled, prefer to endure their discomforts and disabilities rather than submit to a procedure which holds out a somewhat indefinite promise of success. With the advent of the injection treatment, however, the situation has undergone a decided change for the better.

Although comparatively new in America, the method has been in use in Europe for a number of years. The French, German, Scandinavian, and, to a lesser extent, the English literature is voluminous on the subject, and the procedure is everywhere generally accepted and practiced.

HISTORICAL

Attempts to produce occlusion of veins by the injection into them of various substances date from 1851, in which year Pravaz introduced his syringe for the injection treatment of aneurysm. However, due principally to the fact that the solutions formerly used were highly caustic, leading to tissue necrosis and sloughing, and not infrequently to death from septicemia and embolism, the method fell into disrepute and was abandoned.

The present method was originated by P. Linser of Tübingen,[1] Germany. While using mercuric chloride intravenously in the treatment of syphilis, he noticed that the vein after repeated injections became sclerosed and obliterated. He thereupon applied this observation in the treatment of varicose veins, at first making use of mercuric chloride, later changing to the less toxic sodium chloride. Later, the method was popularized in France by Sicard,[2] using first a solution of sodium carbonate, and later one of sodium salicylate. Since then, the employment of the injection treatment has become general throughout Europe.

In the United States widespread adoption of the treatment has been rather slow, owing principally, I believe, to the fear of embolism. *A priori*, this fear would seem to be well founded; practically, however, the danger may be said to be non-existent, for reasons which will be considered later. From a statistical stand-point, there are available many figures demonstrating the innocuousness of the procedure; among the most recent are those of McPheeters and Rice.[3] These investigators collected reports of 53,000 cases treated by the injection method, with a mortality traceable to the injection of 0.0024 per cent. Linser, likewise, states that he has never observed embolism in over 15,000 injections. These figures are unquestioned; they prove that this method of treatment is one of the safest of surgical procedures.

SOLUTIONS EMPLOYED

Contrary to the belief formerly held, which belief was responsible for the ill-repute into which the treatment fell for a time, strong toxic and coagulant solutions are not necessary for success; consequently, the use of carbolic acid, ferric chloride, tincture of iodine, etc., is no longer practiced nor is it justifiable. The principal substances in use today are sodium chloride, sodium salicylate and various sugars. Mercuric chloride is advocated by some, but its use has been rather limited, due to its toxicity; furthermore it has no outstanding advantages to recommend it. Other

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drugs which have been suggested and utilized to some extent are sodium citrate, sodium bicarbonate, and quinine and urethane.

Sodium chloride is most commonly employed in the form of a 20 per cent solution. In this concentration it is nontoxic, produces a firm clot, and may be used with a very fine needle, which is an advantage. However, great care must be taken to see that none of it escapes into the surrounding tissues; also, the cramps immediately following the injection are frequently very painful and severe.

Sodium salicylate is injected in a 20 to 40 per cent solution. It is likewise capable of causing considerable tissue damage in case of leakage or of injection outside the vein, and is also toxic to a not inconsiderable number of patients.

Various solutions of sugars are in use, particularly in Austria and Germany: for example, 50 per cent solution of dextrose, equal parts of 50 per cent solutions of dextrose and levulose, which constitutes the mixture known as calorose,[4] and 75 per cent solution of invertose, or invert sugar. The latter is the one which I prefer for general use. All of these solutions produce excellent thrombi, are much less toxic to the tissues in case of leakage, and the injection is practically painless. However, not infrequently a patient will be encountered who does not react to them, and other substances must then be used. Another minor disadvantage is that concentrated sugar solutions are thick, necessitating the use of a larger needle; this can largely be obviated, however, by warming the solution.

In a recent paper, Kern and Angle[5] have strongly recommended a mixture of equal parts of 50 per cent dextrose and 30 per cent sodium chloride. They state that following the use of such a mixture, the resulting clot is very firm and tenacious, and that no sloughs are produced if the solution escapes outside the vessel wall. I have had no experience in the use of this mixture.

It should be emphasized that one cannot confine his treatment to the use of a single solution. The preparations already described all have their advantages and disadvantages; individuals vary in their reactions. If the desired result is not attained by the use of one drug, the operator must be prepared to employ something else. But for general use, as I have just said, in my experience a 75 per cent solution of invertose has proved most satisfactory. A satisfactory sterile solution is readily available, and is furnished in 10 c.c. ampules.

ANATOMICAL CHANGES

The changes in the vein, both gross and microscopic, brought about as a result of the injection, have been exhaustively studied by many investigators, and the findings are everywhere in agreement.

The recent experiments of Kern and Angle [5] typify these findings. Using various solutions, injections were made into the jugular veins of 28 dogs, which were killed at varying intervals thereafter, and the veins removed and studied both grossly and microscopically. Although the injections were made in a large vein not far from the heart, in which the blood current is swift, and in which considerable negative pressure exists, it is interesting to observe that none of their dogs died of embolism or showed signs of pulmonary infarction.

They record the observed changes in the excised vein segments as follows:

Specimen 1 (48 hours old): There was considerable inflammatory reaction of the tissues surrounding the vein. The vein was reduced markedly in diameter and appeared collapsed. The wall had a dirty grayish color and felt thickened and hard. On section it contained a very firm red thrombus that was not easily dislodged. There was no fluid blood.

Specimen 2 (1 week old): The vein was lying in a bed of fresh scar tissue and was dissected out with difficulty. It was about one-third its original diameter and felt like a solid cord. On section there was a firm thrombus occluding the distal segment. The thrombus was half red and half white and extended

proximally for an inch; it was a tapering mural thrombus.

The 2 and 4 weeks old specimens showed a progressive reduction in the size of the vein and the thrombus, with the ultimate conversion of both into a fibrous cord.

Thus it is seen that the immediate effect of the injected agent is to give rise to an irritation of the endothelium of the vein, with congestion and cellular proliferation. As a result of this aseptic irritation, or chemical inflammatory process, fibrin is deposited in comparatively large amounts, amounts sufficient to occlude the vein in the usual case, and to cause stoppage of the blood stream through it. This takes place within a short time after the injection has been given. Later changes in the weeks following consist in organization and sclerosis of the deposit. Occasionally, particularly in the larger veins, the occlusion may be incomplete, or it may happen that the fibrinous mass may sometimes become canalized, with reestablishment of the lumen of the vessel. The process is thus essentially an obliterating endangitis.

From this brief description, it is readily apparent that the pathological condition produced differs in several important particulars from that present in the condition ordinarily known as phlebitis. In the first place, the reaction is sterile throughout; furthermore, it is rather sharply localized to a definite segment of the vein, the clot is extremely adherent to the vessel wall, no pain or general edema of the extremity is produced, and the final result is to leave the vein as an atrophied cord.

Phlebitis, on the other hand, is usually the result of an infective process; thus it may, and usually does affect large portions of the vein; it also has a decided tendency to spread, frequently extending from the superficial network to the deep, giving rise to edema. The clot is loose; pain is a constant feature. The end-result is entirely different, the vein remaining hard and bulky, with no tendency to atrophy, and extremely susceptible to further attacks of infection.

Finally, and for us this is a most important distinction, phlebitis may give rise to embolism, while the artificially produced, chemical venitis has positively no tendency so to do. As is shown by the experiments already mentioned, a study of the excised segments of affected veins anatomically confirms this clinical fact. In phlebitis, the thrombus is found to be loose and jelly-like, insecurely anchored to the vessel wall; in venitis, on the other hand, it is hard and firm, and very difficult to separate. Microscopically, in the latter condition, the clot is found to be so intimately attached that it may almost be considered as a part of the vessel itself, which is far from being the case in phlebitis.

TECHNIC

For several months past, I have been giving these injections with highly gratifying results. The technic which I employ is as follows:

The usual tests are made to ascertain the competency of the deeper system of veins. With the patient in the standing posture, the leg is carefully examined, and a prominent vein is selected to be injected. A tourniquet is used if necessary to make the veins stand out sufficiently. The skin is washed with alcohol, and the actual site of injection is marked with mercurochrome. This is important, as the veins become less prominent as soon as the leg is elevated. The patient is then placed on a table, lying down, with the head slightly raised. In order to secure a concentrated action of the solution on the inner wall of the vein, it is necessary to occlude for a time the segment of the vessel into which the injection is made. For this purpose, I use an instrument known as the variocclusor. This is an oblong metal ring, 3 inches in its long diameter by 1½ inches in its short. It is provided with a handle by means of which it may be pressed down upon the vein, a segment of which is thus effectually cut off, both proximally and distally. The same result may be obtained by having an assistant use the forefinger

and thumb for compression. For making the injection, I use an ordinary 10 c.c. Luer syringe with a 22 gauge needle; between the syringe and the needle is placed a two-way stop-cock.

The syringe is filled with the solution to be injected, after which the stop-cock is set so that the passage is open from the needle to the exterior, that from the syringe to the needle being closed. With the variocclusor in place, the vein is punctured, and the blood contained in the isolated segment runs out through the stop-cock, allowing the vein to collapse and creating the most favorable condition for the action of the solution on the vein wall. The valve of the stop-cock is then turned so as to open the passage from the needle to the syringe, and the injection is made. Occasionally the pressure in the vein is so low that the blood does not escape; under such circumstances, the valve is turned, a small amount of blood is aspirated into the syringe to be certain that the needle is in the vein, and the injection is then made. No solution should ever be injected until one is absolutely certain that the vein has been entered. Following the injection, the pressure with the variocclusor or with the finger and thumb is maintained for five minutes. A small pad of sterile gauze, held in place by adhesive strips, is placed over the puncture wound, to remain for two or three hours until natural sealing takes place. The patient follows his usual routine thereafter, just as though no treatment had been given.

The amount of solution injected varies, and may be anywhere from 5 to 10, and in some cases, 20 c.c. Enough should be used to fill the isolated segment of vein without causing rupture. In my work, the first injection is usually 5 c.c., regardless of whether the vein is filled or not. I do this in order to test out roughly the susceptibility of the patient's tissues to the solutions used. Following this, if the reaction is more severe than usual, I do not increase the amount of solution at the next injection; otherwise, for the second injection, I employe 10 c.c., and thereafter as much as needed. For the majority of cases, 10 c.c. is usually sufficient for each succeeding injection.

This, briefly and in general, is the technic which I employ, and by which I have made several hundred injections. It is entirely an office procedure, and causes no disability whatever. Special attention, however, should be called to a few points.

DISCUSSION

I make it a rule to administer the treatment in the morning, or if this is not possible, early in the afternoon, I do this in order that several hours may elapse before the patient goes to bed. The recent experiments of McPheeters and Rice[6] have demonstrated conclusively that centripetal current in these dilated veins is extremely sluggish, if not entirely absent, especially in the erect posture. During the interval of time just mentioned, the thrombus has an opportunity to become firmly attached before the horizontal position is assumed. Theoretically, the remote chances of embolism are increased by recumbency shortly after the injection; practically, such an accident probably would not take place, but there is no justification for taking the risk. For this reason, injections in bed-ridden patients are contraindicated.

One must be absolutely certain that the needle is within the lumen of the vein before beginning the injection. As was stated previously, the action of some of the solutions used upon the tissues is disastrous, if any escapes the vessel. Particularly is this true of solutions of sodium chloride and of sodium salicylate. The former gives rise to a peculiar blanching of the tissues, and both quickly cause necrosis and sloughing of large areas. When using either of these, a large syringe full of normal salt solution should be kept at hand: in the event of an injection outside the vein, or of extensive leakage, the tissues should immediately be infiltrated freely and extensively with the physiological saline. While this will not entirely prevent the damage, it causes a marked ameliora-

tion. Sugar solutions do not appear to have this harmful effect upon the tissues; considerable reaction may be produced, but necrosis and sloughing rarely, if ever, occur.

Even though the technic of the injection has been perfect, and it is practically certain that no leakage has occurred, not infrequently certain patients are encountered in whom a decided tissue reaction will take place. This is manifested by a considerable area of redness and induration surrounding the site of the injection, sometimes to a distance of several centimeters. This reddened and indurated area is sore and somewhat painful upon palpation. Such a condition need occasion no alarm. The height of the reaction is usually passed within forty-eight hours, although some induration and increased sensitiveness may remain for several days. Hot fomentations are all the treatment that is necessary, and give prompt relief. In patients presenting this marked reaction, it is my custom to lengthen the interval between the injections, in order that the effects of one may be over before the next is given.

In a few cases, I have noted a localized, transient edema below the site of the injection, apparently in the area drained by the vein which has been occluded. This edema is definitely circumscribed and confined to a small area, it is not painful, gives rise to no inconvenience whatever, and disappears spontaneously within twenty-four hours.

Some writers advise the use of an elastic compression bandage following the injection and during the course of the treatment. I fail to see any necessity for this, and have not used it. In my work, as I have said above, I cover the puncture wound with a small pad of gauze, firmly applied and held in place with adhesive strips. This remains in place for a few hours, until natural sealing takes place, when it is removed by the patient himself.

A few words should be said in regard to pain. With proper technic, the procedure is practically painless. When using solutions of sodium chloride or of sodium salicylate, during or immediately following the injection, painful muscular cramps are sometimes experienced; these also occasionally appear when sugar solutions are used, but much less frequently. Such cramps are evanescent, disappearing shortly after the injection has been completed. The tissue reaction already described and which comes on later, gives rise more to a soreness in the structures affected than to actual pain. Severe pain of any considerable duration, especially if in the area immediately surrounding the point of injection, means that the needle has not entered the vein or that leakage is taking place, and the injection should immediately be discontinued.

In regard to the interval between injections, it is my practice in the average case to inject about twice a week, although the treatment may be given every second or third day. In my opinion, the severity of the reaction should determine the interval, and I prefer to wait until this reaction subsides before again injecting: thus, the length of time intervening may be two days, or it may be a week. It should be emphasized that the treatment must be ambulatory, and there is nothing to be gained by subjecting the patient to unnecessary inconvenience.

Not infrequently patients will be encountered in whom the veins collapse to a marked degree upon the assumption of the reclining position, making the injection very difficult of accomplishment. This may occur even though a tourniquet be previously applied. Under such circumstances, the treatment may be administered with the patient standing, the technic being otherwise the same.

It is my practice to inject the upper part of the dilated veins first; when this is done, it frequently happens that fewer injections lower down are necessary, due to the fact that a main trunk has been occluded, leading to a disappearance of many of the collaterals. In no case, however, should injections be given above the middle third of the thigh. As a rule, I make only

one injection at a sitting, although in the case of a patient with varicose veins in both legs, there is no particular reason why both legs should not be injected at the same time, if desired. However, if the patient should be one of those individuals who react strongly to the injected solution, considerable discomfort would probably result. As already stated, the treatment is, and must be ambulatory; consequently any unnecessary pain and inconvenience is to be avoided. I do not consider two injections into the same leg at one sitting at all advisable; as a matter of fact, the only reason for two injections is to shorten the duration of the treatment, and in the most of these cases, haste is in no wise necessary.

The number of injections necessary varies with each case, and with the number of dilated veins. In a few, one or two will be found to be sufficient; the average, I should say, is from six to eight; and finally, some severe cases will require twelve to fifteen. One must be guided by the conditions present, and inject until all prominent veins are obliterated. It is advisable to keep the patient under occasional observation for six weeks to two months following the completion of the treatment; not infrequently a vein will become apparent which was not to be found earlier, and sometimes complete absorption of the thrombus will be found to have taken place, with consequent non-obliteration of the vein. Such cases require further injections.

CONTRAINDICATIONS

Contraindications to the employment of the injection method are extremely few in number. The most important of these is a history of a recent phlebitis. To inject veins which have been the seat of a bacterial inflammation at any time during the preceding year is to my mind a hazardous procedure; preferably the interval should be considerably longer. It is true that some men with extensive experience feel that it is safe to administer treatment after all pain and evidence of inflammation have completely subsided; for my part, however, I prefer to refuse an occasional case rather than take an unnecessary risk.

And while upon the subject of phlebitis, it must be considered from another important angle. There is no question but that the injected veins may occasionally become the seat of a metastatic infection from some focus elsewhere in the body; such an occurrence is undoubtedly very infrequent, but there is sufficient clinical evidence that it may take place. This being the case, a careful history should be taken of every patient, followed by a thorough general examination; if grossly infected foci are found which are apparently having any decided effect upon the general health of the individual these should be given attention before proceeding with the injections. This has been recently discussed by Kilbourne,[7] and deserves emphasis.

Other conditions which have been advanced as contraindications are old age, nephritis, and extensive edema of the lower extremities indicating deep circulatory disturbances. All of these, in my opinion, are entirely relative. Old age, in itself, provided the patient is otherwise in good general condition, is no reason for withholding injections; if the general health is enfeebled from some cause or other, however, caution should be exercised as it is, well known that such individuals are very liable to thrombophlebitis. Nephritis, unless advanced, I do not consider a contraindication. Edema of the lower extremities must be carefully investigated. The condition very frequently accompanies dilatation and varicosities of the superficial veins, and under such circumstances, a few injections will cause it rapidly to disappear; on the other hand, if it is due to serious disturbances of the circulation in the deeper system of veins, injections will only aggravate it, if indeed, more serious consequences do not follow.

Varicose ulcers are decidedly not a contraindication, but quite the contrary. Treatment by injection constitutes the

most effective and successful means at our disposal today for the rapid and complete cure of these ulcers.

In the employment of this method, untoward results are possible as follows: (1) from toxic action of the injected fluid; (2) from local injury following the injection; (3) from inflammation of the vein following the injection; (4) from gangrene, and (5) from embolism.

The first four of these possibilities may be dismissed with a few words. With the solutions which are generally used today, toxic action is hardly to be thought of, except in the case of an occasional individual who is susceptible to salicylates; under such circumstances, some other preparation should be employed. With proper care in making the injection, there should be no local injury following it. In this connection, it should again be emphasized that extreme care must be exercised in getting into the vein, because these thin-walled, dilated vessels are more difficult to enter than normal ones. Gangrene is to be avoided by first making sure that the deeper system of veins is competent.

EMBOLISM

As to embolism, increasingly large numbers of statistics clearly demonstrate that its occurrence following proper injection treatment of varicose veins is much rarer than following operation for the same condition. In these cases, the tendency toward embolism appears primarily to be very slight, and whatever danger exists may be reduced to a minimum and the operation rendered entirely safe by attention to a few principles, as follows:

To begin with, the cases should be properly selected. Patients presenting themselves with veins as large as the thumb or larger are not suitable for this form of treatment, and should be rejected.

The treatment must be ambulatory. This means that the injections must be given eight or ten hours previous to the patient's usual time for retiring; following the injection, he should be instructed to proceed about his usual daily routine, just as though no treatment had been given.

Injections above the middle third of the thigh are to be avoided.

The first injections should be made as high up as possible in the vein.

Finally, a small amount of fluid should be used for the first injection, in order to ascertain the patient's reaction.

If these principles are observed in all cases treated, no danger of embolism need be feared.

SUMMARY

From a considerable study of the literature, and from my own experience, I am convinced that the injection treatment of varicose veins is the best and most successful treatment for this condition which we have at our disposal today. It has the additional advantage of being purely an office procedure and of causing no interruption to the patient's usual routine; consequently it deserves to be widely employed. In this short paper, I have not attempted to be exhaustive; I have merely tried to describe a technic for administering these injections which I have found to be simple and practical, and which, with ordinary care and attention to detail, can be readily utilized by any physician interested in doing this work.

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INCONTINENCE OF URINE FROM ABERRANT URETER

REPORT OF A CASE*

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OF THE many causes of incontinence of urine in the female, one that is quite rare but satisfactory from the standpoint of treatment, is the opening of an aberrant ureter into the vestibule of the vagina. This condition is of course due to a developmental defect and should be borne in mind and sought for in every case of unexplained incontinence, as the cure of the incontinence is dependent on the correct diagnosis and appropriate surgical treatment. Aside from the occurrence of this condition in gross abnormalities, such as absence of the bladder, monstrosities, etc., the first published clinical report that we have been able to find was by Baker in 1878. He recognized the condition and successfully treated it by implantation of the aberrant ureter into the bladder by way of the vagina. Baker thought that he had a unique case but learned from Jackson of a similar case in Boston City Hospital in 1870. He secured the record of this case and included it in his report. Hartman in 1913 reported 21 cases with ureter opening into the vestibule, and Begg in 1927 has reviewed the literature on the subject in an article on "Incontinence of Urine of Renal Origin" in which he reports a case of aberrant ureter opening into the urethra, and has collected all cases reported of ureters opening into the vestibule or urethra. Of those opening into the vestibule, he found 50 cases. I have found 5 additional case reports as follows: Hayward 1, Juvara 1, Winter 1, Kilbane 2. I wish to add to those reported another case of this anomaly.

Case Report. (Gynec. No. 1010.) Sr. E. Aged sixteen. St. Francis Hospital, Admitted December 29, 1927. Chief Complaint: Leakage of urine.

History. Patient states that as long as she can remember there has been enough leakage of urine to soil her clothing slightly. In the last three years this has been more marked, and patient finds a spot in the bed in the morning. She voids regularly and normally and has no frequency, burning, nor pain on urination.

Menstruation began at fifteen, has been irregular, sometimes flowing twice in one month. Flow lasts five to six days and menstrual cramps are present at times. Last period began on December 27, 1927, and patient is still flowing (two days). No leucorrhea.

She had scarlet fever at nine, but no other serious illness. No operations. There is no history of congenital defects in the family.

Physical Examination. Patient is very shy and retiring and it is difficult to get a good history, as she is ashamed of the ailment. She was brought to the hospital by her associates who stated that the urinous odor was very marked. There was nothing of note found in the general physical examination. No tenderness in region of kidneys. The urine was negative for albumin, sugar, blood and pus. Wassermann negative. On vaginal examination, hymen was intact. On rectal examination, the uterus and adnexa felt normal. Bladder was catheterized and clear urine obtained. Five tenths cm. below external urethral orifice and slightly to the right of the midline, drops of clear fluid were seen escaping at intervals from a small orifice which was visible as a small slit, but which gaped when the fluid was escaping. This resembled a ureteral orifice in the periodic escape of a few drops of fluid. There was no steady drip and at times the intervals were quite long between the discharge of the fluid. Attempts were made to collect sufficient fluid for examination but very little could be obtained. It was clear, and on microscopic examination no pus cells were found. Attempts to pass a small probe into the orifice were not successful, but a No. 5 opaque ureteral catheter was finally inserted for a distance of 4 cm. A few drops of clear fluid came through the

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catheter. With the little finger in the vagina, through the unruptured hymen, the catheter could be felt below and to the right of the catheter placed in the vagina, a photograph was made (Fig. 1).

The *x*-ray pictures show a very tortuous

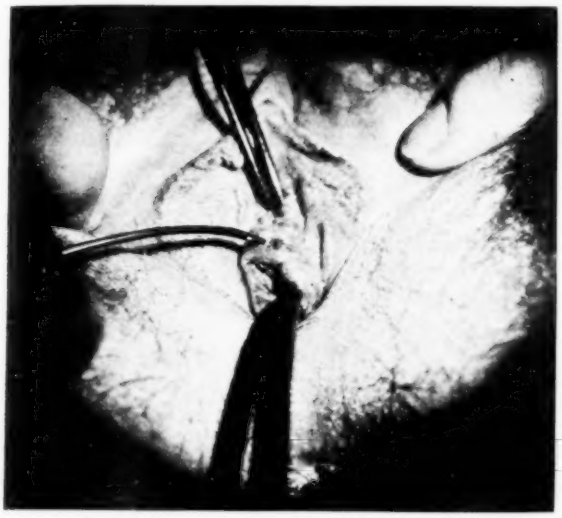

Fig. 1. Two No. 7 ureteral catheters in right and left ureters are shown coming out of urethra. Below and to right of external urethral orifice is shown a No. 5 ureteral catheter in anomalous opening, in vestibule, of one component of double right ureter. Other component opens into bladder. Below this is shown a rubber catheter which has been inserted into vagina through unruptured hymen.

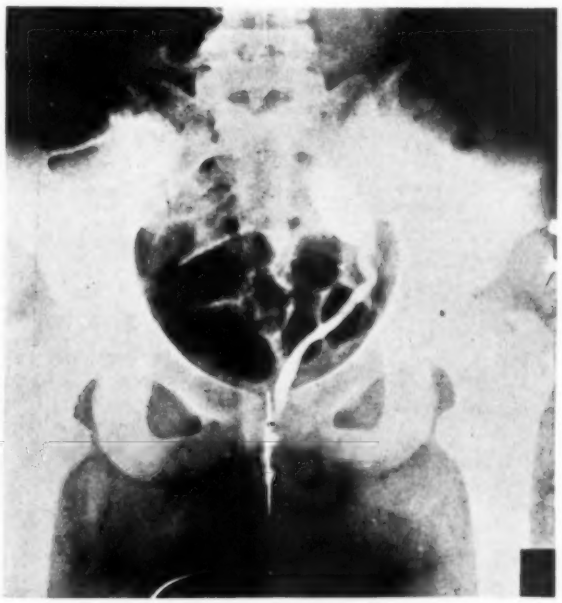

Fig. 2. Shows opaque ureteral catheter in tortuous passage where obstruction was encountered 4 cm. from orifice. Branching off from this is ureter which seems to end in an ovoid dilatation. Ureter is actually dilated all way to kidney but is filled with urine and opaque fluid reaches only lower part of dilated portion.

urethra. 1 per cent mercurochrome was injected through the ureteral catheter, and the catheterized urine from the bladder, following this procedure, was clear and showed no trace of the dye, from which we assumed that there was no communication with the bladder. No dye escaped from the vagina. Twenty per cent sodium iodide solution was then injected and *x*-ray plates made. The following day, patient was cystoscoped and bladder mucosa found normal, and right and left orifices found in the normal positions. No. 7 catheters were readily passed into the ureters and No. 5 catheter again inserted into the anomalous opening, and kidney function test with intramuscular injection of 1 c.c. of phenol-sulphonephthalein was done. The dye appeared on the right side in fourteen and one-half minutes and on left side in fifteen minutes. There was no flow from the catheter in the anomalous opening, so that the appearance time of dye could not be determined. Five cubic centimeters of sodium iodide solution was then injected into each catheter and allowed to remain until *x*-ray plates were made. With ureteral catheters in place and a soft rubber passage containing the No. 5 opaque ureteral catheter which seems to end in a blind passage (Fig. 2). Near the upper end of this passage and branching from it is a normal looking ureterogram extending up the right side of the region of the brim of the pelvis where it ends in an ovoid dilatation. Figure 3 shows this to be distinct from normal right ureter. The ovoid dilatation in the region of the brim of the pelvis gave the impression that this was a case of normal bilateral kidneys and ureters and a third ectopic kidney in the pelvis with a ureter that opened into the vestibule. As only a small portion of the urinary output escaped through this orifice, it was felt that it was an unnecessary nuisance and operation advised for removal of the pelvic kidney.

Operation. January 7, 1928. Before operation a No. 7 catheter was placed in the right ureter as a guide. Under spinal anesthesia, abdomen was opened through low midline incision, the intestines were lifted and gauze pad placed so as to hold them out of the pelvis. It was noted that the cornua of the uterus were

prominent, with a tendency to bicornuate uterus. Tubes and ovaries were negative. Beginning about 1 inch above the base of the

Fig. 3. Pyelograms and anomalous ureter. Photograph fails to show what can be seen on *x*-ray plate that two ureters on right side are distinctly separated as is indicated in accompanying sketch (Fig. 3*a*).

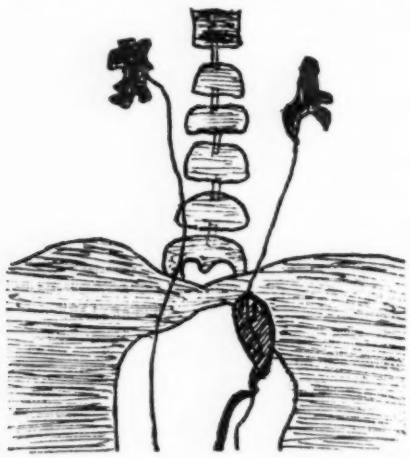

Fig. 3*a*

right broad ligament and coursing upward over the brim of the pelvis was a bluish colored, retroperitoneal, elongated sac about 2 cm. in diameter. It was somewhat tense and was recognized as a dilated ureter. It lay directly over the right ureter in which could readily be felt the ureteral catheter. The peritoneum was incised over the dilated ureter and reflected back. A plexus of veins surrounded the dilated ureter. The ureter narrowed from above downward in a spindlelike manner to about 1 inch above the base of the broad ligament where it was found to be normal in size. The ureter was not opened to determine if there was a stricture here. The dilated portion could be traced upward to the level of the kidney. The lower half of the kidney was slightly larger than normal and felt normal in every way. The upper one-half of the kidney was smaller and more firm and irregular as though cirrhotic. A diagnosis was made of double kidney and ureter, the ureter from lower pelvis opening into the bladder and the ureter from the upper pelvis opening into vestibule of the vagina. As the urine was clear and showed no evidence of infection, excision of the dilated portion of the ureter and upper one-half of the kidney was not thought to be necessary, so the ureter was ligated and divided, below the dilated portion, near the base of the broad ligament where the ureter was normal in size. Through a small muscle splitting incision, a rubber-tissue-drain was carried extra-peritoneally to stump of ureter (probably an unnecessary precaution). The incised peritoneum over the dilated ureter was sutured. The appendix containing a large fecolith causing a fusiform swelling at the tip, so the appendix was removed and midline incision closed without drainage. The rubber-tissue-drain was partly removed in three days; and entirely removed on the fourth day, and patient made an uneventful recovery. There was no incontinence of urine after operation and no pain in region of right kidney.

COMMENT

The interesting features of this case are:

1. The relatively small amount of total urinary output that escaped by way of the aberrant ureter, sufficient only to soil clothing in the day and leave a small spot in the bed at night.

2. The upper dilated portion of the ureter, filled with urine, could not be reached and emptied with the ureteral catheter, so that the injected sodium iodide solution produced a sense of fulness

in region of kidney as though the kidney pelvis were filled, but actually reached only the first portion of the dilated ureter. The ovoid shadow produced here simulated a dilated pelvis of a pelvic kidney.

3. The absence of infection permitted ligation of the ureter as the only operative procedure necessary for the relief of the incontinence. The dilatation of the ureter in this case began higher than is usual in the cases reported. Whether it was a congenital dilatation of the ureter or a stricture of the ureter with dilatation above it, or a valve such as was found by Hunner was not determined, as the ureter was not opened nor excised.

ETIOLOGY

In incontinence due to the ureter opening into the vestibule, there may be a single kidney and ureter on the side involved, but more commonly (in 91 per cent of cases reported) there is a double ureter, the one opening into the bladder and the other into the vestibule. Usually the kidney and ureter of the other side are normal, but in some cases there is double ureter on both sides.

Double ureter is not uncommon but, as a rule, both openings are in the bladder and give rise to no clinical symptoms. Occasionally, however, one component is extravesical and is the cause of the incontinence here considered associated with normal micturition. This anomaly may occur in both sexes. The most satisfactory explanation for this condition was found in Begg's article and illustrated by Figure 4. According to Felix the upper part of the bladder is formed normally from the ventral cloaca, while the trigone is formed from the expanded lower portions of the Wolffian ducts, from the dorsal surfaces of which the original renal buds or future ureters develop. As the Wolffian duct lengthens, after the formation of the trigone, the loop of it passes down internal to the ureter, expanding as it goes, and part of its walls form the urethra and vestibule. When development is complete, it remains in position as Gärtner's duct. If the renal bud is placed high, the trigone

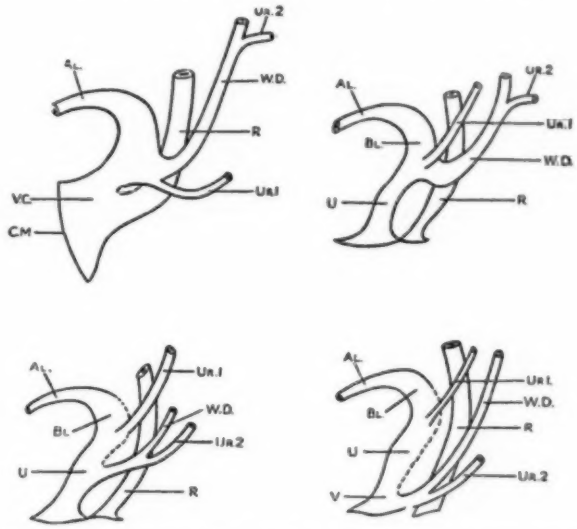

Fig. 4. Diagrams illustrating how lower ureter may open into bladder, and upper ureter into urethra or vestibule. Portions of wall of expanding Wolffian duct form trigone, urethra and vestibule as indicated by dotted line in lower diagrams:

A.L., Allantois: *R.*, rectum: *UR. 2*, upper ureter: *V.C.*, ventral cloaca: *W.D.* Wolffian duct: *C.M.*, cloacal membrane: UR.1, lower ureter: *U* and *V.*, represent the portions that will form urethra and vestibule.

may be formed from the expanded lower end of the Wolffian duct before the portion from which the ureter springs has descended and the ureter may then finally open into the urethra or vestibule, depending on which of these structures are formed from the portion to which the ureter is attached. If it is placed so high that descent of the Wolffian duct has ceased before the part to which the ureter is attached is used in the formation of the vestibule and urethra, it then opens into Gärtner's duct and the flow of urine may keep Gärtner's duct patent. This may be the true condition in many cases of aberrant ureters discharging their contents into the vestibule. In the case reported here the marked tortuosity of the canal for 1½ inch within the orifice as shown in Figure 2, the course of the opaque catheter the tip of which seems to end blindly, while the ureter seems to branch off from the side of the canal, is

evidence in favor of the theory that the distal portion of the canal is Gärtner's duct and not the true ureter in this case.

In double ureter two renal buds arise from the same Wolffian duct. Usually, they lie close together and open close together in the bladder. If one arises much higher than the other, the lower one may open into the bladder at approximately the normal position, while the upper one later descends to open into urethra or vestibule. This explains why the ureter with extravesical opening always comes from the upper pelvis of the double kidney.

PATHOLOGY

Of the 56 cases reported, including the one reported in this paper, with termination of ureter in vestibule, 5 were single ureters, and 51 were components of double ureters. The right side is more commonly involved than the left, and the opening is usually to one side of the midline, thus indicating from which kidney the ureter comes. The opening usually lies at the edge of the external urethral orifice or a short distance from it as in my case. (Fig. 1.) It is round or slitlike and usually quite small so that it is difficult to pass a probe or a small catheter. On passing a catheter, obstruction is often encountered from 1 to 2 inches from the orifice. This has been attributed to stricture, or angulation of the ureter due to fixation near the normal site or entry of the ureter into the bladder, or possibly to the ureter entering a patent Gärtner's duct, which was strongly indicated in my case. The ureter is usually dilated due to stricture at the orifice, or strictures higher in its course. Through the vagina it is possible to palpate the dilated ureter as a cystic swelling, in many instances. As this anomaly usually occurs with double kidney and ureter, it is the rule, as one would expect from the embryology, that the ureter with extravesical opening arises from the upper kidney pelvis. The urine is usually infected and this is important in regard to treatment. Function is decreased in the portion of the kidney involved, as a rule.

SYMPTOMS

The characteristic symptom is incontinence, day and night, along with normal micturition. As the kidney function is usually below normal and as the ureter is usually dilated and acts as a reservoir, the amount of urine escaping is often small in amount and quite variable as to time and quantity. It may be influenced by posture, exercise, etc. There may be pain in the region of the kidney due to back-pressure or infection. Urinous odor and irritation of mucous membrane and skin of vulva and thighs is common. This type of incontinence in the female may be due also to an aberrant ureter opening into the urethra, but is more common in the vestibule (3½ to 1). In the male, the aberrant ureter opens into the prostatic urethra, seminal vesicle, or vas deferens. As these openings are behind the external sphincter, there is frequency of urination, but not incontinence as in the female.

DIAGNOSIS

Many of these cases are undoubtedly missed because the condition is not borne in mind as a cause of incontinence. The characteristic type of incontinence should call attention to the possibility of this condition and a search made for the extravesical orifice. Preceding the examination the patient should be given large quantities of water in order to increase the flow of urine, and then a careful inspection of the vestibule should be made for the escape of urine. Since the intervals between the discharge of urine were quite long in the above case, several examinations may be necessary where the condition is suspected. As the incontinence may be due to the ureter opening into the urethra. Furniss has recommended the insertion of wet cotton pledgets into the urethra, the vagina, and the vestibule following the injection of indigo-carmine, to determine from which of these three sites the colored

urine escapes. After locating the orifice it will be noticed that urine escapes intermittently as from the ureteral orifice in the bladder, but often with less regularity. On vaginal examination it may be possible to palpate the cystic dilatation of the ureter above the external orifice. If the orifice lies to the side of the midline it indicates that the ureter comes from the side in which the orifice is located. It may be necessary to dilate the small orifice in order to introduce a small ureteral catheter. Injection of sodium iodide followed by *x*-ray examination is a valuable aid in determining the side involved, the course and degree of dilatation of the ureter, and the form of the kidney pelvis. It must be remembered, however, that if it is not possible to pass a catheter far enough to empty the dilated portion of the ureter, the *x*-ray examination may be confusing. This was true in my case where it was not possible to pass the catheter more than 1½ inches. The ureter was dilated and tense with retained urine above this portion, so that it was not possible to inject the sodium iodide solution to the kidney, and the *x*-ray pictures gave the impression of a third kidney at the brim of the pelvis (Fig. 3). Similar apparent sacculations were found by Kilbane and also by Low and Epler, due to stricture above. This should be borne in mind before assuming that there is a third kidney present. Except for the difference in location, Herbst's skiagram of a rudimentary upper pelvis is very similar to the skiagram of dilatation of the ureter shown in Figure 2.

On cystoscopic examination, the presence or absence of a ureteral orifice on the corresponding side of the trigone determines whether the aberrant ureter is single or a component of a double ureter. If the latter, the function and the presence or abscense of infection in this portion of the kidney emptying into the bladder can be determined. Simultaneous ureterograms of each component will determine the relation of the aberrant to the normally placed ureter. The urine from the aberrant ureter should be examined for pus and microorganisms.

TREATMENT

Various procedures have been used to cure the annoying incontinence and at the same time preserve the kidney or portion of kidney involved. In case of single ureter with good function of the kidney involved, implantation of the ureter in the bladder is indicated. Implantation by way of the vagina has not proved very satisfactory and has frequently resulted in vesicovaginal fistula, requiring multiple operations. Judd advocates abdominal extraperitoneal implantation as more satisfactory. He performed this operation in the presence of infected urine, and with careful after-treatment and lavage of kidney pelvis obtained a fairly satisfactory result.

In the absence of infection in a case of double ureter, ligation of the aberrant ureter is sufficient for cure. In the case here reported this was done through the abdomen. A catheter in the normally placed component of the double ureter was a valuable aid in differentiating it from the aberrant component. It is much simpler to ligate from below by dissecting out and resecting the lower end of the ureter by way of the vagina. Kilbane and Furniss both doubt the advisability of ligating the ureter in any instance. In the case above reported where the function of both kidneys emptying into the bladder was good while that of the portion of the kidney secreting through the aberrant ureter was much below normal, the ureter was dilated high up, possibly due to stricture, and the urine was not infected, ligation was simpler and surer than implantation into the bladder, and less formidable than resection of the kidney. To satisfactorily implant the ureter into the bladder in this case, it would have been necessary to open the ureter in the dilated portion and dilate the ureter below this level to overcome stricture before implantation into the bladder. It is also true that

implantation has not been altogether satisfactory. Some of the cases could not be catheterized after a few months and function ceased, due to contracture of the orifice, so that in the end the result was practically a ligation.

Unfortunately, most of the cases are not so favorable for ligation as the one here reported. The usual case is one in which the ureter is dilated, the kidney function impaired and infection present, and with a normal kidney on the other side nephrectomy is usually done, either removal of the entire kidney or resection of the upper portion with its pelvis and dilated ureter. The latter procedure is probably the one of choice in most cases. A sulcus usually marks the limitation of the upper pole, and by a wedge-shaped incision at this level, the upper pole may be excised. Care must be taken to preserve the blood supply of the remaining portion of the kidney and this operation is best performed when each portion of the kidney has an independent blood supply.

SUMMARY

1. There is a type of incontinence of urine in the female, associated with normal micturition, which is due to the opening of an aberrant ureter into the vestibule or urethra.

2. The aberrant ureter may be single, but there is usually a double ureter, one part opening into the bladder and the other outside of the bladder.

3. The aberrant ureter is usually strictured, dilated, infected and associated with the upper half of the kidney with impaired function.

4. The diagnosis is made by the character of the incontinence, the finding of the external orifice, and cystoscopic and *x*-ray examinations.

5. The treatment is implantation of the ureter into the bladder, ligation of the ureter in clean cases, or in the majority of cases resection of the infected kidney or portion of kidney.

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OSTEOMYELITIS*

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OSTEOMYELITIS is an inflammation of the marrow of the bone, and may be acute or chronic. Its point of origin depends on whether the bone infection is primary or secondary. When bone suppuration results from compound fractures or punctured wounds, it begins at the point of inoculation, but when it is caused by bacteria, usually Staphylococcus aureus, conveyed from some focus of infection to the bone through the blood or lymph vessels, it ordinarily begins in the juxta-epiphyseal region. The rapidity with which the invading bacteria destroys the surrounding bone, depends largely on their virulency, the resistance of the surrounding tissue, and the ability of the pus to escape from its point of origin.

In the primary cases the portal of entry frequently remains open, providing a most favorable type of drainage with repair proportional to the amount of mechanical, but non-destructive cleansing of the minute areas of the infected bone. However, in the secondary there is a very different situation with the acute cases. The blood current in the sinus-like vessels is slowed at the seat of election for this disease. Then some slight injury is sufficient to produce in the delicate epiphyseal tissue a bruising of the vessels and an effusion of blood which temporarily interferes with the nutrition of the part. Minute fractures of the bony trabeculae are frequently found after such injuries. At these points the bacteria which may be circulating in the blood move in a comparatively confined vascular area, and readily find lodgment in the bruised tissues or the blood clots.

Where the pathological process originates, the tissues are very unyielding and this greatly favors a rapid spread of the inflammation through the Haversian canals, through which the blood vessels pass. Swelling, which is the saving and essential characteristic of inflammation, cannot take place in the bone in osteomyelitis. As soon as the limit of expansion in the marrow is reached, the products of inflammation next exert themselves on the internal blood supply of the bone. The blood vessels are quickly occluded, the nourishment of the bone lying within the periosteum is cut off, the circulation being supplanted by stasis and coagulation. This dead structure is rapidly infected, resulting in necrosis and abscess. Pus under pressure is the most dangerous thing in the animal organism, and this exists in acute ostemyelitis as in no other disease. It is one of the most serious of diseases. Loss of life is common, permanent disability may be expected in a large percentage of cases, and bone destruction in every case.

The clinical picture is that of a severe illness, often beginning with delirium and prostration before evidence of affection of any bone. There may be rigor, general illness, severe headache, vomiting, rapid pulse, pain in the limbs, and sometimes convulsions. The temperature is septic, often going to 104°F. There is a marked leucocytosis. Pain is intense in one or more of the bones. Any movement of the neighboring joint or jarring of the limb causes agony. Intense tenderness can be produced by the most gentle pressure. A tap on the bone some distance from the maximum point of tenderness will cause severe pain at that point, but no discomfort where the pat was made. Swelling is not an early sign, and that with redness appear only after the moment for advantageous treatment is long passed. In the early diagnosis of the disease the roentgen ray is of no value.

The differential diagnosis is of upmost importance. In acute rheumatism the pain

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shifts from place to place, rigors are absent, the lesion is in the joints and is multiple, heart affections are early and the lesion never leads to suppuration. In acute osteomyelitis, on the other hand, the pain is constant in one spot, rigors are present, the lesion is in the bone and is usually single, heart affections are late, and the lesion leads rapidly to suppuration. In cellutitis the bone itself is not tender and the movements of the extremity, though painful, are free. With erythema nodosum over the tibia the patient has good health, free movement of the part, and there is a peculiar purplish appearance to the part. It is more difficult to differentiate from scurvy, rickets and acute periostitis which have a whitish, somewhat edematous appearance of the skin and superficial tissues. Also movements are painful and bones are tender on pressure and frequently limited to one bone at first. Fever is absent and other signs of rickets are present. Erysipelas over the tibia gives signs closely resembling acute osteomyelitis.

The prognosis should always be guarded. By early recognition and thorough treatment much illness is prevented, necrosis limited, formation of persistent sinuses often prevented, and the patient is comparatively soon out of danger.

There is only one treatment and that is operative. At the point of maximum tenderness expose the bone and evacuate the pus either by the removal of a generous piece of bone or by drilling several holes. Many methods may now be employed for drainage and to aid bone and tissue regeneration. The one which gives the greatest mechanical cleansing, with a non-irritating solution, or pack, generally gives the more rapid, and more often permanent healing. Those most widely used now are the Carrel-Dakin and the Orr vaseline packs with immobilization of the part. Since 1919 I have used the Taylor[1] liquid-tight appliance with most excellent results.

[1] I have followed closely the teachings of Drs. W. H. and N. B. Taylor of Toronto, Canada, in the use of their liquid tight appliance, and I make no claim of original work while using it.

After evacuation of the pus destruction ceases. Such portions of the periosteum and medulla as have retained their vitality resume their bone-forming functions. A covering of new bone is now being formed around the area of necrosis and is called the involucrum. This is perforated by apertures called cloacae, through which pus flows profusely. The dead bone which lies adjoining, or within, the involucrum is a marked stimulant to the surrounding tissues. When it is finally completely separated from the living bone, largely through the activity of the osteoclasts, it is called a sequestrum. This may be a part of the outer covering of the diseased bone, and, if left alone, may be expelled through the fistulous opening in the integument. Not infrequently large fragments of bone may be extruded in this way. If the sequestrum has become imprisoned within the wall of new bone, it will be necessary to remove a piece from the wall large enough for the removal of the dead bone.

We have now come to one of the most difficult problems in surgery, that of chronic osteomyelitis. The type which has just been described follows the acute or subacute and is caused by the pyogenic organisms. Another type is Brodie's abscess. It is a small, circumscribed, cold abscess in the shaft of long bones and its etiology is not definitely known. Still another type is chronic (non-suppurative) hemorrhagic osteomyelitis. It begins in the same areas of bone structure as the acute form. The process of bone disintegration is very slow. It follows injuries of moderate or even slight severity.

The lesions of tuberculosis of the bones with their accompanying abscesses are very familiar to every practitioner. However, we must differentiate that lesion from those closely resembling it, so that we will make the mistake of taging every chronic abscess of a bone with the diagnosis of tuberculosis.

Congential syphilis causes bone lesions which are constantly being treated for

tuberculosis and with disasterous results. A negative Wassermann reaction should not rule out congenital syphilis.

Bone cysts and tumors frequently resemble chronic osteomyelitis.

The discussion of treatment will be confined to that of chronic osteomyelitis caused by the pyogenic organisms.

Many different treatments were used for a few months or years, and given up because of their failure to accomplish what its originator claimed for it. Many cases did not heal. Of these which did heal many broke down afterwards, leaving sinuses communicating with cavities in the interior of the bone. Attempts were made to completely sterilize the abscess cavities with some strong antiseptic, as pure carbolic acid, followed by alcohol, after using the chisel or currette. Frequently this caused a superficial necrosis, resulting in the formation of another sequestrum. Many investigators are hoping to find an antiseptic that will sterilize the abscess cavity and not damage the tissues. For some time it was thought that Dakin's solution with Carrel's technic had solved the problem. I have given the method a fair trial and I do not believe there is any particular advantage in it, or that it is the use of the antiseptic that materially influences the course of the disease.

Still believing that if the cavity could be thoroughly cleansed and filled with a foreign body which would prevent further necrosis and stimulate osteogenesis, the following methods were tried. Most of them have been discarded because they met with too high a percentage of failures.

Following the experiments of Lister, that sterile blood clot rapidly undergoes organization, being converted into new bone in two or three months, several investigators sterilized the cavity with a strong antiseptic and immediately sutured the periosteum, muscles and skin. The results were varied.

The bismuth-iodoform paste of Morison was lightly packed in the cavity and a rubber drain used for forty-eight hours. Beck's bismuth and vaseline paste has met with a varying degree of success, and is still quite extensively used. Cavities have been filled with bone dust, bone fragments, or the decalcified bone chips of Senn, but met with a high percentage of failures because of the presence of sepsis in the cavity.

After an attempt at sterilization, Hamilton, filled the septic cavities with pieces of sponge, but with poor results. Iodoform gauze, antiseptic cotton, catgut, and other organic substances have been used to obliterate the cavity after an attempt at sterilization, all meeting with frequent failure.

Many successful cases have been reported from the use of the pedunculated flaps of fiscia or muscle which have been allowed to fall into and practically fill the cavity. Here the living flap rapidly adheres and supplies the much-needed nourishment, not only for osteogenesis, but for combating the remaining infection. The vitality of these flaps is not interfered with by the presence of mild infection.

The older methods of simple or multiple incisions with rubber tubing or gauze drains and moist dressings, the continuous bath kept at about 102°F. or the wide open wound packed lightly with moist dressings, are still in use and meeting with an encouraging percentage of success.

There have been many failures and a few brilliant results following extensive subperiosteal resection. The operation, both immediate and delayed, should be strongly condemned. However, when a long bone has been destroyed, or the shaft of the tibia removed for necrosis, a fibula has been successfully used to fill the gap.

As the Carrel-Dakin method completely neglects the numerous small pockets of pus leading off from the main cavity, the infection frequently spreads, necessitating an early re-opening of the abscess cavity.

It is not the value of any antiseptic solution, but the thorough mechanical cleansing and greatest possible dilution of the septic agent, that allows an abscess

cavity to completely heal. That is why I gave up the Carrel-Dakin method nine years ago, and have used the Taylor liquid-tight method since then. By means of a liquid-tight appliance, a wound may easily be inundated to its remote parts. Although any solution may be used, a 5 per cent salt solution gives most excellent results. Because of its osmotic character it opens the way to the hidden pockets causing cleansing and healing the same as in the main cavity. Usually after thirty-six hours the suppurative processes have been brought to a standstill by carrying the pus away as soon as it is formed, and rendering the bacteria inert through dilution.

When the level of the fluid in the supplying reservoir is 18 in. above the surface of the wound, the fluid will continue to flow until the wound and all its offshoots are inundated. Then the flow will cease and the pressure becomes equalized throughout all parts of the system. There is nothing violent about this fluid pressure. It is a gentle but very insistent seepage which occurs, probably taking several hours for the fluid to permeate all depths of a wound. The pus mixes freely with the irrigating fluid, and after the seventh cycle there will be a dilution of one in several millions, which is one of the most valuable aids in removing infection and allowing healthy granulations to form. A cycle is usually the inflow (positive pressure) for one hour and the outflow (negative pressure) for fifteen minutes.

The negative pressure established hyperemia and lymphorrhea, which are of greater importance than the thorough cleansing of the cavity.

Heat, which is often necessary to promote an adequate reaction in a wound, can be used to any temperature which the surgeon feels is to the best advantage for healing. The temperature of the fluid may be raised each time a fresh supply is run in from the reservoir.

The salt solution does not water-log the tissues. On the other hand, it has strong osmotic properties, rapidly reducing swelling and drawing bacteria from remote pockets, where other solutions could not reach them. In long-standing cases the bacterial count usually increases markedly during the early stages of the treatment. It then drops rapidly to its previous level, then to a very few or none, in several fields. Swelling and tenderness disappear very rapidly. The thick exudate of pus changes to clear serum in from three to seven days. The appliance is then discontinued. A closed sterile safety-pin for drainage, and dry sterile dressings changed daily, is all that will be necessary.

If the exudate changes to pus before healing takes place, repeat the irrigations for two or three days. It has been a dictum for ages, "where there is pus let it out." Dr. Taylor says, "ebb and flow irrigation goes a step further and insists: where there is pus wash it out and keep it washed out."

In Dr. Orr's own words:

The proposition upon which the treatment of wounds by drainage and rest was worked out as follows:

1. Primary asepsis or antisepsis to reduce the focal infection. It is not attempted to remove all infection or all diseased tissue. The patient is relied upon to take care of a part of his infection if he is properly assisted and protected.
2. Adequate drainage.
3. A postoperative dressing or method that will protect the wound and the injured or diseased part so that the wound and the part are at rest and there is no opportunity for re-infection.
4. Immobilize so that movement, pain, and muscle spasm are entirely relieved.

The exact technic is as follows:

1. Make a fairly large incision over the infected bone area. Spread apart the skin, muscles, fasciae, and periosteum just far enough to afford access to the diseased area and no farther.
2. Chisel a window into the affected bone area large enough so that all diseased bone may be removed and so that there are no overhanging edges of bone over the diseased area. (Less extensive in acute cases.)

3. Clean out the diseased area gently with a currette or gouge, being careful to refrain from unnecessarily damaging the tissues undergoing repair.

4. Dry the wound and wipe out with 10 per cent iodine followed by 95 per cent alcohol.

5. Pack the entire wound wide open but not tightly with a sterile petrolatum gauze pack. Cover this with a dry sterile pad and bandage on.

6. Apply a plaster cast.

7. Finally, the cast is not to be split nor are windows to be cut in the cast until the wound dressing becomes necessary, which may not be required for several weeks. Complete healing may be obtained with a few dressings at intervals of from ten days to four weeks.

As all the orthopedic services at the Los Angeles General Hospital have been using the Orr treatment during the past two years, I shall give a brief summary of the results. There have been about 50 cases during that time. Five chronic cases were healed in from three to five months. The last one left the hospital about six months ago and so far there has been no recurrence. They were packed on an average of from two to four weeks. If they were not draining very much then only once in two months. The longest chronic case is of nineteen months' duration, is still in the hospital, not healed but greatly improved.

The acute cases, including an acute recurrence of an old osteomyelitis, healed in from four to seven months with a few recurrences. One acute case which was in the hospital fifteen months left two weeks ago, apparently completely healed.

The conservative management of chronic osteomyelitis will prevent, far more frequently than radical procedures, the miserable train which follows prolonged infection, that of ankylosis or restricted movement of joints, destruction and sclerosis of muscle, necrosis and non-union of bone, to say nothing of lowered morale.

I heartily agree with Brickner when he says:

> I quite appreciate, and I too have often yielded to, the temptation to perform an extensive osteotomy in these cases of chronic osteomyelitis with sinuses, suppuration and one or more sequestrums. One hopes by chiseling and scraping away to a solid column of so-called healthy bone to eradicate the disease process at once, and to effect a prompt and permanent wound closure. How often such hopes are disappointed! Every chisel stroke, every scrape of the curet is an invitation to fresh sequestrum formation; and the extensive osteotomy often serves to delay rather than to hasten the cure.

MILK INJECTION IN PELVIC INFECTION*

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IT IS generally accepted that the use of foreign protein therapy is sound and productive of good results in a great many cases. It is also safe to state that the great majority of workers have adopted sterile cow's milk as the agent of choice. Robert Schmidt of Prague,[1] who introduced the procedure, "selected milk because it was always available even in the remotest village and because its source, the organism of the cow, seemed to him as reliable as any laboratory."

It is our practice on the Second Gynecological Division, Harlem Hospital, Service of Dr. H. C. Falk, to use plain cow's milk from which the top cream has been removed, boiled in a water bath for ten minutes in a sterile test tube. Ordinary ice box milk is used simply because of the item of expense; while satisfactory, it is recognized that the wide possible bacterial variation in certified milk and milk that has been opened and exposed constitutes a real barrier to accurate scientific observation.

The effect on the organism of the injection of sterile milk, as stated by Gellhorn,[2] Petersen[3] and others, may be summed up as "due to plasma activation. All the cells of the organism are stimulated to greater activity none more so than those cells which have been weakened or paralyzed by infection." Leucocytes are increased in number and are more active; there is consequent increased production of antibodies and enzymes. There is also increased tolerance to intoxication and increase in permeability of the capillaries, promoting increased lymph flow and freer exchange between blood plasma and cell content. Clinically, there is usually increased activation in the lesion, evidenced by swelling, some febrile reaction and increase in tenderness, which soon subsides with prompt improvement of subjective and objective symptoms.

CONTRAINDICATIONS

Pulmonary tuberculosis, alcoholism, various cardiac lesions and diabetes are recognized contraindications. Pregnancy is also listed as a contraindication. We have not used milk injections in any case of pregnancy; therefore, we are unable to record any experience. Petersen[3] warns against its use if there is a history of hypersensitiveness, asthma, urticaria, angioneurotic edema. Recognizing this possibility, although Gellhorn[2] states, "anaphylactic shock need not be feared; only three cases of this kind have been reported in the literature of the world," we have not as yet felt it necessary to inject intradermally a small amount of milk to determine sensitivity.

Reactions varying from slight local tenderness to severe constitutional effects, such as chills, fever and vomiting, are described. In the great majority of cases reactions do not constitute an objection to this method of treatment.

We have observed no cases of abscess formation and no induration or local irritation other than transient in our cases. We should hesitate, however, to use non-sterilized milk, although Duke[4] "uses pasteurized hospital milk kept in ice-box at temperature of 50°F. This milk is not sterilized but is centrifuged and the milk drawn up into the syringe with the needle well below the cream line." He also states, "in a short series there was no abscess formation and patients experienced only a temporary discomfort or soreness."

In our 22 cases, 14 had no reactions. Three cases were recorded as having

* Read before the Clinical Society of Harlem Hospital, October 31, 1929.

reactions. In one case there was a slight chill after the first injection (this patient had five injections). In 2 cases there was a moderately severe reaction with leg and general body pains after the first injection. In one case the reaction was so severe, with headache, vomiting, joint pains, and malaise coming on about two hours after injections, the milk was discontinued after the third injection. This patient, while she had an increase in temperature and a marked increase in leucocytes, felt distinctly worse. Most observers agree that the mild reactions might possibly be due to the accidental injection of a small amount of milk into a vein. It is also agreed that it is good practice to make sure a vein has not been punctured by withdrawing the piston a trifle before injecting. Surface anesthesia by ethyl chloride spray allays nervous apprehension and is distinctly worthwhile.

Averett[5] reports "in first six cases violent reactions, severe chills, fever and refusal of patient to continue." Since the general use of fat free milk as suggested by Graves[6] it is uncommon to find reports of consecutive violent reactions.

EFFECT ON TEMPERATURE

The temperature was recorded before and six hours after injection. As a rule, the temperature showed a rise of from 2° to 3°F., the average being 1.5°. The next day there was a reduction in temperature from 1° to 3°F., showing a net reduction of about 1°. The temperature was normal after two injections in 3 cases; after three injections in 3 cases; after three injections in 4 cases. The average number of injections given was 4.8. In one case the milk was discontinued after five injections, the temperature becoming normal three days after the last injection.

EFFECT ON LEUCOCYTE COUNT

Averett[5] states: "I have found a leucopenia with a decrease in polynuclear but increase in lymphocytes chiefly the small lymphocytes."

The leucocyte count total and differential was taken immediately before and six hours after injection. There was an increase in the total count of from 2000 to 8000, the average increase being 3000 to 4000. For some reason, in a small percentage of cases there was a decrease in the polymorphonuclear count, amounting to from 4 to 10 per cent. Our experience thus differs from that Averett and conforms to the experience of the majority of workers.

EFFECT ON CLINICAL COURSE

Twelve patients were promptly and distinctly improved. One patient was not benefited; 2 patients did not feel distinct improvement until three days after the injections were discontinued. In the majority of cases clinical improvement was marked after the second and third injections.

No patient was given milk injection until five to seven days of conservative treatment had failed to reduce temperature and afford subjective relief. Upon admission each case of pelvic inflammation is immediately put on conservative treatment: absolute rest in bed, elevation of head of bed, ice bag to abdomen, low simple enema daily or every other day, hot alkaline douches morning and night. This routine is usually sufficient to effect reduction of temperature and marked clinical improvement in five to seven days. The cases in this report failed to respond to this routine; their improvement, in our opinion, was unquestionably due solely to foreign protein therapy. Included in this report are:

	Cases
Pelvic cellulitis	3
Pyosalpinx	9
Postabortal sepsis	4
Sepsis with parametritis	4
Gonorrheal arthritis	1
Pelvic peritonitis	1

It seems reasonable, therefore, to conclude:

1. Milk injection is a valuable adjunct

in the conservative treatment of pelvic infection.

2. It is without uncomfortable local or systemic reaction except in a very small percentage of cases.

3. Marked increase in the total leucocyte count and a corresponding increase in the polymorphonuclear is the rule; in 75 per cent of cases the temperature promptly returned to normal after milk injections.

4. Definite clinical improvement was noted in 60 per cent of cases.

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SPINAL ANESTHESIA AND SHOCK STRETCHER*

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NEW YORK

THE stretcher illustrated was suggested by the ill effects caused by the transportation of spinal anesthesia patients from the operating table to their beds on the ordinary stretcher, on which it was impossible to maintain a head low position, so vital in these cases.

Fig. 1.

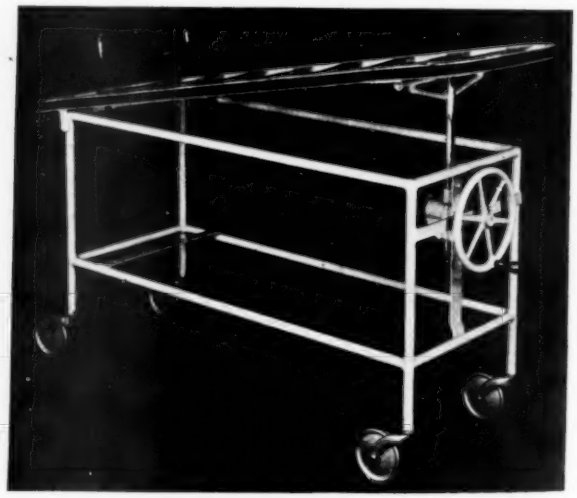

Fig 2

The new stretcher provides for this position by being hinged at the head end, and the desired foot elevation obtained by operating a worm gear by means of a handle at the foot end of the stretcher.

Shoulder braces, which prevent the patient from sliding, are slipped into slots on one of the transverse bars of the stretcher. These slots are so placed that they are adjustable to three widths. The lower framework of the stretcher is fitted to hold the braces when not in use.

This stretcher has also been used to great advantage in tonsil and adenoid cases and in cases of shock. For pelvic drainage cases it can be used in the reverse position, and in any case as the ordinary stretcher.

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FRACTURES OF THE PELVIS*

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UNDER this heading we include all fractures of the innominate bones, the sacrum, and the coccyx. The innominate bone is formed by the fusion of the pubis, ischium and ilium. This fusion is not complete until the twentieth year of life. In children are found a considerable number of conditions resulting from trauma to the pelvis in which the component bones have not yet firmly fused; these may be termed sutural separations. The adult pelvis is essentially a ring or girdle. The posterior and lateral parts of this ring may be regarded, both mechanically and functionally, as an arch which connects the skeletal parts of the trunk with those of the lower extremities. The two main functions of the bony pelvis are to give support to the body, and to give protection to the lower abdominal and pelvic viscera. In the standing position the line of support passes upward from the femora through the acetabula and the iliac bones. In the sitting posture the ischia take up a large part of this function. The pubic rami, and to a lesser extent the inferior rami of the ischia, are not greatly concerned in the constant stress and strain which results from supporting the weight of the body, and are, consequently, the smallest and weakest bones in the pelvis. It is one of the functions of the pubis to give firmness to the pelvic ring by holding the lateral and posterior bones together.

Any external force or violence applied to the pelvic ring as a whole will cause its weakest part, the pubis, to give way first. This is borne out by our series of 33 cases in which a total of 80 fractures occurred, 45 of which involved the pubic rami (See Table III). In Sever's[5] report of 51 cases 25 involved the pubis, while Westerborn's[8] figures are 161 pubic fractures out of a total of 491 fractures in 306 cases. Experimental support is given this view by Shaw[6] who placed a cadaver in a vise with parallel sides and applied pressure over both trochanters. A great force was required to produce an audible break. Subsequent radiograms showed factures of both horizontal pubic rami and both inferior ischial rami. No fractures occurred in the trochanters, nor in the acetabula. All this evidence bears out the belief that the pubis is the most commonly fractured pelvic bone.

Fractures of the iliac wing and the sacrum occur with direct violence of

TABLE I

Case	Aged	Sex	Side of Fracture	Number of Fractures	Days in Hospital	Days Convalescent	Total	Permanent Disability
1	26	F	Left	2	20	28	48	None
2	38	M	Right	1	5	30	35	None
3	26	F	Both	2	7			Not known
4	37	M	Right	3	38			Not known
5	69	F	Right	2	1			Not known
6	30	M	Left	1	24			Not known
7	39	F	Both	4	103	188	291	None
8	68	M	Left	2	36			Not known
9	38	M	Left	2	6	248	254	75 Per cent
10	31	M	Left	3	22	30	52	None
11	34	M	Both	5	57	30	87	None
12	41	M	Both	4	55	62	117	None
13	22	F	Left	3	68	45	113	None
14	43	M	Right	1	31	24	55	None
15	16	M	Left	1	62	5	67	None
16	34	M	Right	2	8	29	37	None
17	47	M	Right	2	20	78	98	None
18	38	M	Left	3	37	29	66	None
19	32	M	Right	1	12	34	46	None
20	26	M	Both	2	45	36	81	None
21	33	M	Right	2	9	59	68	None
22	43	M	Left	3	42	24	66	None
23	29	M	Both	4	62	118	180	None
24	36	M	Left	1	35	118	153	None
25	48	M	Right	2	112	193	305	90 Per cent
26	43	M	Left	1	28	87	115	None
27	48	M	Left	3	54	46	100	None
28	22	F	Both	4	25	70	95	None
29	69	M	Right	3	57	0	57	Died
30	48	M	Both	4	56	70	126	20 Per cent
31	27	M	Both	4	107	110	217	None
32	56	M	Left	1	55	54	109	None
33	72	M	Both	2	80	*100	*180	*25 Per cent

* Estimated.

* Submitted for publication June 11, 1929.

those bones. The acetabulum is fractured only when sufficient force is applied to the shaft of the femur just below the greater trochanter and in line with the long axis of the neck of the femur. Separation of the symphysis pubis (which we consider under the heading of fractures because the symphysis is not a true articulation, but a cartilaginous union of bones) occurs in our series only in connection with other fractures and in severe injuries. In general the same is true of sacroiliac separations.

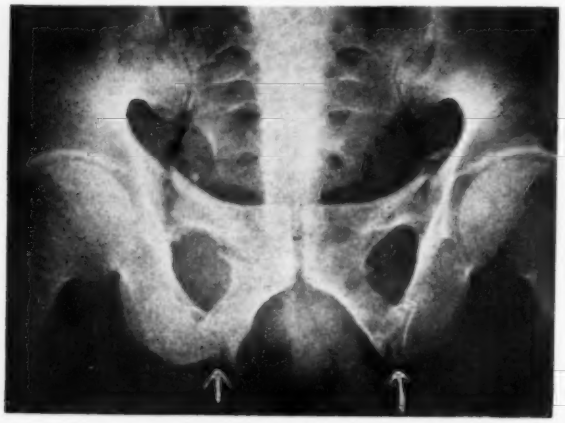

Fig. 1. Roentgenogram of Case xxx, showing four fractures of pubis.

Fig. 2. Roentgenogram of Case iv. Double vertical fracture of Malgaigne.

Table II

ETIOLOGY OF PELVIC FRACTURES

Cause of Fracture	Case Number	Total	Per Cent
Falls	5, 8, 11, 14, 16, 18, 21, 23, 25, 32, 33	11	33.3
Auto accident	1, 2, 3, 4, 6, 7, 17, 28, 29	9	27.2
Crushing injury	9, 10, 15, 20, 22, 26, 27, 30, 31	9	27.2
Other injuries	12 Struck by foreign body 13 Jumped from burning bldg. 19 Knocked off truck 24 In falling elevator	4	12.1

ETIOLOGY

According to available statistics fractures of the pelvis comprise approximately 2 per cent of all the fractures of the human skeletal system. There is, in our practice, a noticeable increase in their incidence in the last five years. Our experience is that pelvic bones are fractured usually through direct violence or indirect violence. Only a very few result from muscular action. Table II shows that falls were responsible in 11 cases, automobile accidents and crushing injuries in 9 cases each, and various other injuries in 4.

Unique in the literature are 2 cases reported by Steiner[7] in which spontaneous multiple fractures occurred in the pelves of men of middle age, who for a number of years had been undernourished and had developed a starvation osteomalacia. Boorstein[1] reports 6 cases of separation of the symphysis pubis in pregnant women due to difficult labor, the injudicious use of forceps and contracted pelvis. We have no experience with the two last-mentioned causes.

CLASSIFICATION

The following classification of pelvic fractures is suitable for the present discussion:

1. Fractures of the pubis. This is the most common variety and makes up 56 per cent of all the fractures in our series (Table III). Out of a total of 33 cases of

fractures of the pelvis 23, or 70 per cent, had fractured one or more rami. Of these, 9 fractured one ramus, 10 two rami, and 4 four rami of the pubic bone, making a total of 45 fractures of the pubis in a grand total of 80 fractures. Figure 1 illustrates this type of fracture.

Fig. 3. Roentgenogram of Case xxv. Fractured acetabulum.

Fig. 4. Roentgenogram of Case xvii. Separation of sacroiliac synchondrosis and of symphysis pubis.

Table III

SUMMARY OF PELVIC FRACTURES

Bones Involved	Cases	Total Cases	Total Fractures	Per Cent of All Cases	Per Cent of All Fractures
Pubis					
One ramus	3, 4, 5, 8, 11, 21, 23, 24, 33	9	9	27.2	
Two rami	1, 7, 9, 10, 13, 16, 18, 22, 27, 29	10	20	30.3	
Three rami	0	0	0	0	
Four rami	12, 28, 30, 31	4	16	12.1	
		23	45	69.7	56.25
Ischium					
One ramus	4, 5, 6, 8, 11, 15, 23	7	7	21.2	
Two rami	7	1	2	3.0	
		8	9	24.2	11.2
Ilium	4, 11, 14, 19, 21, 25, 29, 32	8	8	24.2	10.0
Pubic separation	10, 11, 13, 17, 20, 23, 27	7	7	21.2	8.5
Sacrum	11, 18, 20, 26, 33	5	5	15.1	6.2
Acetabulum	2, 22, 23, 25	4	4	12.1	5.0
Sacroiliac separation	3, 17	2	2	6.0	2.5

2. Fractures of the pubis with fracture of the ilium just posterior to the acetabular cavity or near the sacroiliac joint, the so-called double vertical fracture of Malgaigne (See Fig. 2). This fracture occurred twice in our series.

3. Fractures involving the acetabulum. This fracture was present in 4 of our patients. It is the type referred to by Sever[5] as the most disabling of all pelvic fractures, especially when complicated by central dislocation of the head of the femur. (Fig. 3.)

4. Separation of the symphysis pubis or of the sacroiliac articulation. These conditions occurred in association with other fractures usually. In case xvii both of these separations occurred without any other fracture. In our series there were 7 pubic and 2 sacroiliac separations. (See Fig. 4.) The degree of separation may vary from an almost imperceptible distance to several inches.

5. Fractures of the sacrum or of the ischium. These occur in severe injuries and usually accompany other fractures of the pelvis. The ischium was fractured in 8 patients, one of whom had both sides involved, while the sacrum was broken 5 times. Only one such fracture was uncomplicated by other fractures. Two of the sacral fractures were due to falls on the buttocks and both developed postsacral hematomas, one of which was estimated to contain as much as 500 c.c. of blood. The question of shortening the con-

valescence by aspiration came up but was rejected because of the danger of secondary infection. Both hematomas slowly absorbed spontaneously, leaving no trace behind. (Fig. 5.)

Fig. 5. Roentgenogram of Case xviii. Fractured sacrum.

Fig. 6. Roentgenogram of Case xix. Isolated fracture of ilium.

6. Isolated fractures of the ilium. This type occurred eight times in our series and is thus not uncommon. It is not of great importance because usually the pelvic girdle is left intact. (Fig. 6.)

Fractures of the pelvis may be complete or incomplete. Most often a complete fracture is accompanied by considerable displacement and overriding of the fragments. This is especially true in the fracture of Malgaigne and in other double vertical fractures. When all four of the pubic bones are broken through there is formed a disconnected fragment lying anteriorly, often markedly displaced. Extensive splintering of the bones is quite common and often accompanied by penetration of the soft tissues by the splinters. Tears occur which involve the pelvic viscera. No instance of compound fracture of the pelvis has come to our notice.

DIAGNOSIS

The diagnosis of pelvic fracture is often overlooked, especially when other fractures have taken place concomitantly. It can usually be made on the following points:

1. There is a history of a severe injury, followed in many cases by profound shock which adds gravity to an already serious condition.

2. Pain is usually complained of by the patient. It can also be elicited by compressing the iliac crests, by flexing the thigh on the abdomen, or by backward pressure on the anterior superior iliac spines when the patient is in the recumbent position.

3. Loss of function is especially marked if the fracture is at all extensive. There is great difficulty in standing and walking.

4. The signs of local trauma vary with the location and the extent of the fracture. Ecchymosis and discoloration in the perineum should lead one to suspect fracture of the pubis. Similar signs over the buttocks should lead one to careful examination of the sacrum.

5. Crepitus is easily elicited, especially where the ilium or the pubis is involved. This method of investigation must, however, be indulged in sparingly.

6. Deformity is sometimes discernible with difficulty, especially in thickset patients. In spare persons marked asymmetry may be detected at a glance. This is especially easy when the pubic bones are fractured, or when there is a separation of the symphysis pubis. In central fracture dislocation of the acetabulum with inward displacement of the head of the femur through the acetabulum a decided lessening of the trochanteric prominence is evident.

On rectal or vaginal examination the head of the femur may be revealed in the true pelvis.

7. Measurements. These usually confirm the appearance of the asymmetry or deformity; the most reliable measurements being those from the umbilicus to the anterior superior iliac spines.

8. Preternatural mobility can often be elicited by grasping the anterior superior spines in the palms of the hands and exerting pressure directly backwards. In many cases grasping one leg and moving it with an alternate pushing and pulling motion will reveal movement of the fractured parts.

9. A vaginal or rectal examination should both be made where any doubt exists as to the possibility of isolated fractures of the sacrum, coccyx, or ischium. The method of Lewin[3] is to insert the index finger into the rectum and palpate the coccyx and the sacrum between that finger and the thumb. Abnormal mobility and crepitus are easily detected. Thus is furnished also sometimes the first evidence of severe injury to the pelvic organs.

10. A roentgenological examination is of paramount importance in all cases, for a considerable number of the fractures of the pelvis escape recognition otherwise until sometime following the injury. The symptoms may be masked by shock, or the surgeon's attention may be drawn to other simultaneously produced injuries, such as fractured ribs or vertebrae. It is very significant from the medico-legal aspect that one get visual demonstration of the pelvic bones to establish evidence as to possible fractures. It is a curious fact that the absorption of bone along a linear fracture will often serve to increase the contrast in a picture taken two or three weeks after the injury and to make the line of fracture easy of demonstration. For that reason it may become necessary, in doubtful cases, to take a second radiogram about three weeks after the injury. One should not forget in examining *x*-ray films that occult spina bifida and other congenital deformities are comparatively common conditions, and should, therefore, be recorded at the first examination, because such abnormalities serve as a basis for unfair claims by unscrupulous damage-seeking litigators.

TREATMENT

The transportation and movement of patients with fractures of the pelvis must be done with the greatest care, both on account of the shock already present and for fear of producing or increasing visceral injury. In all instances the patient should be transported in an ambulance to a hospital after first aid has been given in the form of a wide moderately firm bandage around the pelvis to immobilize it. The knees may likewise be tied together to steady the broken parts.

After the patient is placed flat in bed shock demands the first consideration, and a complete physical examination is made at once.

If there is bleeding from the urethra or from the rectum the source of such hemorrhage is established at once. The patient is warned against passing the urine for fear of pelvic extravasation. It has been our practice to pass a sterile soft rubber catheter at once in order to avoid this, and if blood comes from the urethra the catheter is fixed in place. Failing to pass a catheter usually implies serious laceration of the urethra and suitable operative treatment is demanded.

It is rarely necessary to make elaborate attempts at reduction of the fractured fragments, for, as a rule, they tend to reduce themselves after the patient is placed flat on his back. Where there is an upward displacement of the acetabulum on one side extension should be applied in order to avoid shortening. We use only enough weight to counterbalance the muscular pull, as this is enough to cause a gradual replacement of the fragments to a more or less normal position. In women of the childbearing age the potential complication of narrowing of the pelvic

outlet must be kept in mind and an attempt made at proper reduction. Overriding of fragments of the pubis can often be easily corrected by simple manipulation with one or two fingers in the rectum or vagina.

Fig. 7. Fronto-distal view of plaster-of-Paris case applied for fracture of pelvis.

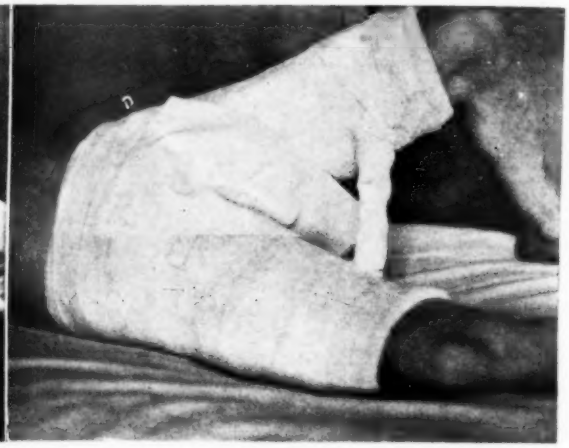

Fig. 8. Anterolateral view of plaster-of-Paris case applied for fracture of pelvis. Pictures taken about four weeks after application.

The essential principle to be kept in mind in the treatment is immobilization. This was secured in Westerborn's[8] cases by bed rest with or without a girdle or sling. We have found plaster-of-Paris cases of the body extending from the umbilicus to the middle of the thighs the most satisfactory method. They are especially comfortable and give complete safety to the patient who must be turned and lifted for baths and other toilet necessities. Our practice is to wait from one to several days for the patient to overcome his shock and to secure reposition of the fragments by extension and traction. After that he is placed on a fracture table and supported on the sacral saddle. Next to the skin is placed the usual stockinet and this covered by a well-applied dressing of several layers of cotton wadding, fastened down by a turn or two of gauze bandage. Felt pads are next placed over the bony prominences of the sacrum, the iliac crests and spines, and the trochanters. These felt pads are fixed in place by the first few turns of plaster-of-Paris bandages, so that they will not slide about nor work away from their proper locations. The legs are now abducted far enough to form an angle of about 30° with each other, and the plaster-of-Paris is applied. A cross-bar is fixed between the thighs to facilitate handling and turning of the patient in his bed. Figures 7 and 8 show the appearance of such a case when finished and dried. In some patients it may be necessary to leave the extension on the leg and apply the plaster case over it, later resuming the traction. Where the symphysis is widely separated, or where the sacrum is fractured, it is well to put on the case with the patient suspended in a sling rather than to make use of the sacral rest on the fracture table. No anesthetic is required for application of a plaster case. After four to six weeks the case is removed, but the patient is kept in bed for several weeks more in the severer cases. The actual stay in the hospital varies greatly according to the extent of the fracture, and also according to the type of personal care demanded by the patient. In our series the smallest number of days spent in the hospital after the injury is one, the greatest 112, the average 43 (See Table 1).

In those cases where multiple incisions of the perineum or a suprapubic cystotomy may become necessary we place the patient

on a simple rectangular frame over which two sheets of canvas are tightly stretched, so as to leave a 7 inch gap between them running across the middle of the frame. When the patient's buttocks are placed into this gap the pelvis is given more or less fixation, which can be easily augmented by a tight band from side to side of the frame over the top of the symphysis. Such a frame is very satisfactory also from the point of view of sanitation and the care of urinary drainage.

There are few, if any, indications for open reduction of fractures of the pelvis. Wiring and suturing of the symphysis pubis have been recommended, but we have not had occasion to do this. Fracture of the coccyx may be followed by continued pain. In those cases the bone should be removed.

For central fracture dislocation of the head of the femur and acetabulum we consider the method of Whitman[9] the procedure of choice. Fixation of the pelvis is secured by full abduction of the intact leg, after which sufficient abduction of the involved leg will stem the trochanter against the upper acetabular border and rotate the head of the femur down and out into its normal position. The usual case is applied for immobilization and also moderate traction to overcome the muscle pull. This method is also advocated by Eliason and Wright[2] who report a series of 15 cases, some of which were of severer degree of deformity than any of ours. The method of skeletal traction used by Putti,[4] who drives a steel pin through the trochanter, we think is too elaborate and opens avenues for infection of the bones. We have not experimented with it.

COMPLICATIONS

In our experience the most common complication of fracture of the pelvis is rupture of the pelvic viscera. In 7 cases, or 21 per cent, there was laceration of the urethra, rupture of the bladder, or tearing of the rectum, with subsequent fistula formation in 2, or 6 per cent. Both of these we demonstrated definitely by the injection of dye solutions, and, what is more interesting, both eventually closed spontaneously. The visceral injuries accompanying pelvic fracture form the material for another paper and will not be discussed further here. (See Table IV.)

TABLE IV

COMPLICATIONS OF PELVIC FRACTURES

Case	Complication	Treatment	Result
7	Ruptured urethra Ruptured bladder	Operation	Rectovesical fistula
9	Ruptured urethra Osteomyelitis of the pubis	Operation	Perineal urinary sinus and 75 per cent incapacitated
10	Ruptured urethra	Indwelling catheter	Complete recovery
16	Ruptured urethra bony spicule pierced bladder	Indwelling catheter	Complete recovery
18	Sacral hematoma	Rest	Complete recovery
20	Ruptured urethra	External urethrotomy	Complete recovery
23	Fract. vertebra	Rest	Complete recovery
25	Fractures of 6 vertebrae 6 ribs	Rib resection	Empyema
26	Sacral hematoma	Rest	Complete recovery
*29	Cerebral hemorr.		*Death
31	Ruptured urethra Ruptured rectum	Operation, transfusion	Satisfactory recovery
32	Fractures of clavicle and one rib	Rest, splint	Complete recovery
33	Ruptured urethra Fractures of three ribs	Indwelling catheter rest	Convalescent

* Complication not due to pelvic fracture.

Concomitant fractures elsewhere in the body were present four times (12 per cent) and became a very serious factor in one instance. Case XXV fractured a number of transverse vertebral processes and six ribs on one side. A hemothorax developed and later an empyema, which had to be drained by rib-resection. The patient, eighteen months after the injury, is still incapacitated, not from the pelvic fracture but from the complicating fractures of the ribs. Case XXXIII had three fractured ribs, and cases XXIII and XXXII a fractured lumbar vertebra and clavicle, respectively. All proceeded to uneventful recovery. Westerborn[8] states that these two complications are the most common in his

series, 30 per cent being complicated by other fractures and 16 per cent by rupture of a pelvic viscus.

Postsacral hematoma was present in cases XVIII and XXVI. Both absorbed spontaneously without special treatment.

Osteomyelitis of the pubis occurred in one case following extravasation of urine. A perineal urinary sinus existed for several months but eventually closed spontaneously.

Case XXIX was an old man with generalized atherosclerosis in an advanced degree. He died of a cerebral hemorrhage (substantiated at autopsy) a few days after leaving his bed. It is probably safe to state that this condition was not a true complication of his pelvic fractures.

Two complications with which we have no experience are fat embolism and injury of the sacral plexus.

PROGNOSIS

We find that uncomplicated and properly treated pelvic fractures proceed to complete recovery in the vast majority of cases. A protracted convalescence or permanent disability are usually due to complications. Westerborn[8] reports that 93 per cent are restored without marked incapacity. In our experience 85 per cent are free from disability, while 15 per cent are more or less permanently incapacitated. The ultimate results in 5 of our cases are not known to us. We have reason to believe, however, that they are entirely satisfactory, since the extent of their injuries was of the less serious nature and no complications were present in any of them.

A word of explanation is probably necessary here. It is our custom to regard a patient as free from permanent disability if he is able to return to his former occupation or one simi ar in nature. Thus it becomes obvious that a patient completely restored functionally may show some slight anatomical changes which we have here disregarded. Ability to perform his usual daily work is the criterion of our results. This seems to us the fairest basis upon which to estimate the final consequences, since all but 5 of our patients are workers active in some industrial occupation.

A few outstanding points of the material here presented are of interest. (Tables I and III.) The ages range from 16 to 72 years; average age being 40 years. There are 6 females and 27 males. The left side alone is involved 13 times (39 per cent); the right 10 (30 per cent); both sides 10 times (30 per cent). The smallest number of fractures in one patient is 1; the greatest 5; the average 2.42. The total number of fractures in all 33 cases (not including complicating fractures) is 80. Eight patients have a single fracture (24 per cent); 11 have 2 (33 per cent); 7 have 3 (21 per cent); 6 have 4 (18 per cent); and 1 has 5 fractures (3 per cent). The greatest number of days of treatment before final discharge is 305; the least 35; the average 95 days.

SUMMARY AND CONCLUSIONS

1. Pelvic fractures are the result of severe injuries, most common of which are falls automobile accidents, and crushing injuries.

2. There is a gradual increase in the incidence of pelvic fractures in the last few years.

3. The most common site of fracture is the pubis.

4. Conservative treatment should be in order unless definite operative indications present themselves.

5. Injuries of the urethra and bladder are the most common complications.

6. The most serious factors are not the fractures *per se* but the visceral complications.

7. Surgical shock usually accompanies fractures of the pelvis and should receive immediate and primary consideration.

8. Taken as a whole fractures of the pelvis offer a very favorable prognosis both as to life and as to function.

[For references see Author's reprints.]

CYSTINE CALCULI

REPORT OF THREE CASES*

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NEW YORK

TREATMENT of urinary calculi is always a tedious and difficult surgical problem because of the possibility of recurrence. The treatment of a patient with cystine stones is both medical and surgical, and even after resorting to every known remedy, we often find that we have failed. The greatest problem is not in the surgical removal of the stones, but in preventing their reformation which results in damage of the kidneys and impairment of renal function.

HISTORY

In 1810 Wollasten[55] read a paper before the Royal Society of London "On cystic oxide, a new species of urinary calculus." He described two stones, one of which had been removed in 1805 from a boy five years of age and the other from a man of thirty-six. He called them cystic oxide since both had been removed from the bladder. Berzelius[30] in 1822 proposed the name cystine because the substance was found to be not an oxide. The first observations on patients were made by William Prout[40] in 1821 who described one with cystinuria and one with a cystine bladder stone. Lassaigne[22] in 1823 found a cystine stone in the bladder of a dog. Baudrimont and Malagutti[30] in 1837 discovered that cystine contained sulphur but Thaulow[47] in 1838 was the first to determine the correct chemical formula.

As early as 1840 William Prout[40] states that the cystic oxide disease is of an hereditary character and occurs in members of the same family. He also points out that the peculiar composition of cystic oxide shows that its formation results from an imperfect assimilation of the albuminous principle and seems to be a peculiar form of hepatic disease. Strangely enough this corresponds very closely to our modern conception of the disease. Dewar and Gamgee[13] in 1901 discovered cystine in the sweat. Drechsel and Cloetta[9] found cystine in the liver of a horse and in the kidney of an ox. Spiegel[18] in 1901 proved that cystine was an intermediary product of protein metabolism. Cystine was produced from horn and hair synthetically by Embden,[16] and by the hydrolysis of keratine by Morner.[36]

Udranszky and Baumann[49] in 1889 believed there was some connection between cystine diseases and intestinal putrefaction. Another theory of the origin of cystine in the urine brought forth by Stadthagen and Brieger[45] says that it is caused by an intestinal mycosis because of the presence of certain diamines in the urine and feces of cystinurics.

In 1856 Thoel[48] showed the familial occurrence of cystine by finding it in several members of the same family. Charles A. Simon[18] in 1900 collected from literature 103 cases of cystine stones.

DESCRIPTION

Cystine chemically is a very complicated organic compound. It belongs to the group of amino-acids, being the only one which contains sulphur. Its sulphur content is about 25 per cent.

Cystine is absolutely necessary for the growth of the body. Feeding experiments on rats and dogs have shown that cystine is an essential amino-acid and hence necessary in the diet if growth and maintenance of body weight is desired. Cystine and cysteine cannot be synthesized in the body.[38] Some cystine, however, is stored in the muscles and is called endogenous cystine, in contradistinction to the exogenous cystine which is utilized directly

* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, May 15, 1929.

from the food protein. Lewis and Lough[24] believe that the ingested cystine is properly assimilated and utilized by the body and of cystine. The Chinese edible birds' nests, which are formed by the mucin-like salivary secretion of these birds, contain the

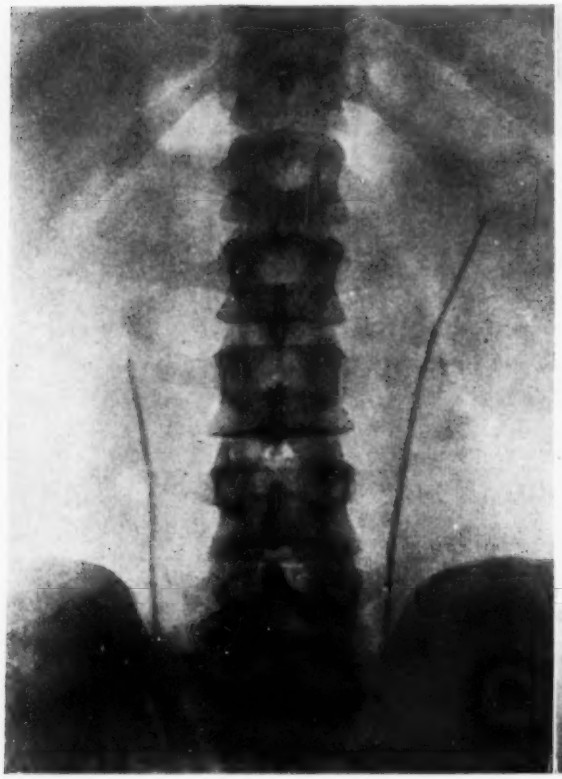


Fig. 1.

Fig. 2.

that cystinuria is the result of improper catabolism and thus almost entirely endogenous in origin. They failed to find any appreciable difference in the excretion of cystine on a high or low protein diet even when cystine itself was added. An experiment by Robson[41] showed that the average cystine excretion on a high and low protein diet varied from 1.1 gm. to 0.71 gm., and concludes that the cystine excretion is in almost direct ratio to the protein in the diet. Further experiments have shown that neither cysteinic acid, taurine, or any other substance is capable of replacing cystine.[23]

Since cystine is an indispensable essential amino-acid and growth is limited by a low cystine diet, we would expect a high cystine content in food which is most important for infant feeding. Thus the lactalbumin of milk contains 4.5 per cent greatest amount of cystine.[52] All proteins contain some cystine but the amount varies considerably. Milk, nuts, beans, whole wheat bread, rye, eggs, oats and meat contain much cystine, while corn, gelatin, cheese, lentils, peas, cow-peas, and red kidney beans contain much smaller amounts.[56] Fish contains less cystine than any other meat.

It was formerly believed that normal urine contained no cystine. According to investigations by Looney,[57] slight traces may be found in normal urine averaging about 4 mg. in 100 c.c. of urine. This corresponds approximately to one-third the amount one finds in the urine of a cystinuric. Cystine crystals, however, are not found in normal urine but only appear after this limit is exceeded.

Cystine occurs in cystinuria as hexagonal, colorless, highly refractive crystals, occa-

sionally in the form of needles. Cystine stones are of a honey-yellow, waxy appearance. They have a somewhat crystallized appearance and a peculiar semitransparent luster. They may be very small or large enough to completely fill the kidney pelvis. These stones may be purely cystine but are often mixed with other salts. Pure cystine stones have no distinct laminae, but appear as a mass confusedly crystallized.

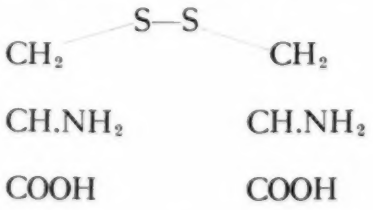
There are three methods of determining the amount of cystine: (1) gravimetric (Gaskell[17]); (2) polarimetric (Magnus-Levy[33]); and (3) colorimetric (Looney[57]). Cystine is readily soluble in alkalies but not in alcohol, acids or water. It decomposes readily in the urine.

F. W. Wards in 1923 published some very interesting experiments in which he shows that cystine is the only amino-acid that has any marked absorption of ultraviolet light. He says:

> It would appear suggestive that the presence of cystine in hair and wool (where the concentration approaches 10 per cent) is of physiological importance in the protection of the organism against the harmful effects of prolonged exposure to sunlight. The curious custom of the Arabs in wearing heavy but loosely fitting woolen clothes has apparently a strong justification in the protective effect of the cystine present in the wool.

CHEMISTRY

The chemical formula of cystine according to Friedman and Neuberg[30] is:



By oxidation this is split into two molecules of cysteinic acid. These products of cystine are stored in the blood cells, liver, and tissues, and hold the oxygen in various parts of the body for use. Hence they regulate the equilibrium between the oxidants and reductants of the cells.

Cystine and tyrosine have been isolated from hydrolyzed crystalline insulin, proving the presence of these amino-acids in

Fig. 3

the "insulin molecule."[51] Cystine is a derivative of insulin in which cystine is probably linked to the rest of the molecule by a peptide linkage.

TOXICITY

The toxic action of large doses of cystine has experimentally been proved by many workers. Lignac[28] in 1925 found severe tubular injury of the kidneys in mice from the subcutaneous injection of a suspension of cystine. H. B. Lewis[26] in 1925 fed cystine to rabbits and produced similar injuries to the kidneys. Curtis and Newburgh[58] in 1927 reached the following conclusions from experiments on white rats: (1) An 8 per cent casein diet does not contain sufficient cystine to permit good growth. (2) The basic diet of 18 per cent casein contains sufficient cystine for growth. (3) Cystine in the diet becomes harmful when it contains roughly two and a half

times the requirement and with increasing amounts of cystine the injurious effects become more and more severe. A 5 per cent addition of cystine works as a powerful poison and 10 per cent kills the rats in a few days, causing a diffuse hemorrhagic necrosis of the renal parenchyma.

Fig. 4.

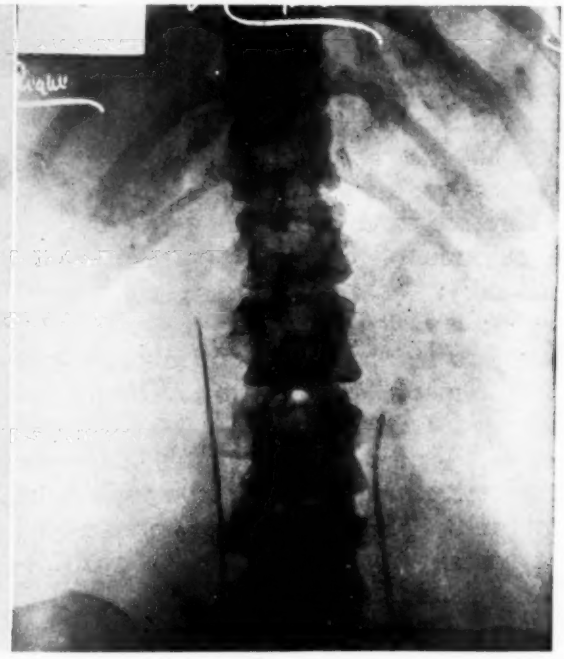


Fig. 5.

Cystine also exerts a toxic action on the liver when large doses are administered. A complete necrosis of the liver is caused in four days by adding 20 per cent cystine to the diet.

Cystine apparently exerts no toxic effect in cystinuric patients except rarely in very young children where metabolic disorders are extremely severe. Abderhalden[1] and Lignac[29] have reported autopsies on four children who died from inanition in which cystine was found in most of the internal organs. The body requires, or can use, a certain amount of cystine and only a portion of the cystine from the ingested protein is excreted as such, the remainder being used by the body in the normal manner. The metabolism of cystinuric patients apparently suffers no other abnormality. They are usually well developed and entirely normal in every other respect. Many individuals who excrete large amounts of cystine go through life with out any difficulties, and it is only when calculi are formed in the urinary tract that symptoms occur. Watson and Cunningham[46] report 1 stone-forming patient in 32 cystinurics, Morris[37] 2 in 77 cystinurics, and Sir Henry Thompson reports 3 in 114 patients excreting cystine. Thus only 2.5 per cent of cystinuria cases form stones. About 70 per cent of the reported cases are in males.

Alsberg and Folin[3] have proved that the amount of cystine excreted in the urine in a case of cystinuria varied directly with the amount of protein consumed. From 30 to 50 gm. of protein per day is the minimum for normal metabolism, and this amount causes considerable cystine excretion.

SYMPTOMS

It is an interesting feature of cystinurics that they often reveal a history of passing stones sometimes for many decades with only slight transient symptoms. Usually the first symptom noted is renal colic with or without the passage of a stone with hematuria. General malaise or a feeling of

weight in the loins is not uncommon. An attack of renal colic may last from fifteen minutes to two or three weeks. Cystine crystals are usually found in the urine although cystine stones have been removed from the kidneys of patients whose urine never showed cystine crystals. MacAlpine[32] noted that the urine of cystinurics on decomposition had a foul odor, probably due to the sulphuretted hydrogen produced during the decomposition of cystine. A silver coin in the pocket of a cystinuric may turn black from the sulphur of the cystine present in the sweat.[13]

Cystine diathesis is an hereditary metabolic error. The youngest cystinuric reported was a baby of ten and one-half months and the oldest a man of eighty-one years.[30] This latter patient had never had alarming symptoms although he had passed stones for over thirty years. Cystinuria may be transitory or it may persist throughout life. It often occurs in many members of the same family. Poland, Strasser, Morner,[36] Cohn,[10] Pfeifer,[39] Marcet, Civiale, Thoel,[48] Golding-Bird, Hatuier, Ebstein,[14] Lichtenstein,[27] Kretschmer[21] and others have all reported more than one case in the same family.[30]

Cystine stones may be located anywhere along the urogenital system: urethra, prostate gland, bladder, ureter, kidney pelvis, or renal parenchyma. Nothing can be said of the frequency of their location, as only recently with the development of cystoscopic and *x*-ray examinations has it been possible to locate them accurately. They are more liable to be multiple than single. Schottmueller[43] and Edwards[15] have reported cases with more than one hundred stones.

Cystine has also been found outside the urinary tract. Mueller[21] reported cystine in the blood in a stubborn case of urticaria; Umber and Burger,[50] in the muscle; Sherer, in the liver; and in the mesentery and other internal organs by Abderhalden[1] and Lignac.[29] Cystine may occur in the urine in phosphorous poisoning, tuberculosis or syphilis.

There is considerable difference of opinion regarding the *x*-ray shadows cast by cystine stones. Kuemmell[6] states very

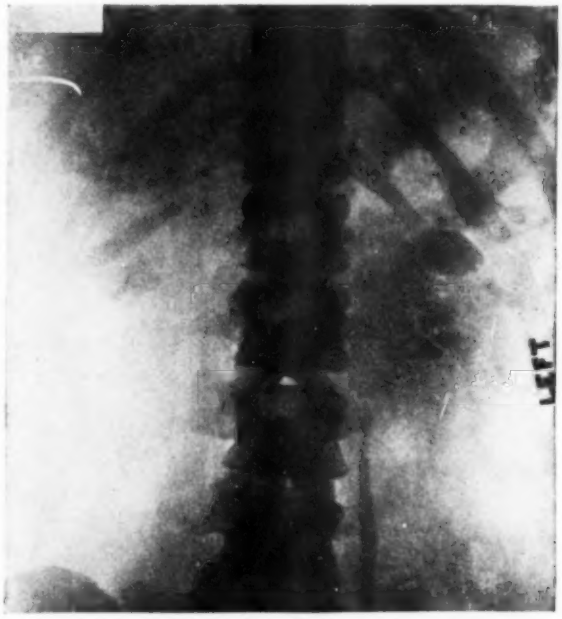


Fig. 6.

definitely that cystine stones do not throw an *x*-ray shadow. In a case reported by E. Beer[6] the *x*-ray showed the large stones but not the smaller ones. Graves says that cystine stones should not cast an *x*-ray shadow while Thomson-Walker[46] state that cystine and xanthine give shadows almost as dense as calcium phosphate. Mueller and Stallman reported cases which cast good shadows with the *x*-ray. Morris[37] states that many cystine calculi contain calcium phosphate or magnesium and ammonium phosphate, but that cystine contains from 25 per cent to 75 per cent sulphur and therefore should cast a very deep shadow. Winsbury White[54] states that cystine and xanthine give poor shadows when in the pure state but of slightly more opacity than those of urates, uric acid, and triple phosphates, because of the sulphur they contain.

TREATMENT

The oldest and still the most modern treatment of cystine calculi is the internal administration of alkalies. Both Cantani[8]

in 1881 and then Beale[5] (in 1884) advised large doses of ammonium carbonate and successfully treated their patients in this manner. In 1914 Jacobi and Klemperer[19] strongly recommended the alkalinization of the urine with 10 gm. of sodium bicarbonate.

Fig. 7.

Fig. 8.

Looney found that the neutral sulphur in the urine remained unchanged regardless of the amount of alkalies given and therefore believes that the cystine was merely in solution and not actually decreased in amount. Smillie[44] demonstrated a decrease in the sediment in an alkaline urine but not in the amount of cystine excreted.

Crowell[11] in 1924 described a case where he succeeded in disintegrating kidney stones and keeping the urine free from cystine by the internal administration of alkalies.

Klemperer[19] and Smillie[44] advocated about the same treatment which consists in the oral administration of 6–10 gm. of sodium bicarbonate daily and a low protein diet. Every attempt to eliminate cystine from the diet by adding very similar chemical compounds failed completely.

Edwards[15] advises the use of choleic acid on the hypothesis that endogenous cystine is excreted because of the lack of choleic acid with which it should normally conjugate to become the taurine of the bile salts. This has proved of no benefit. He also suggests intestinal and urinary antiseptics to allay the pelvic infection which furnishes the irreversible colloid that glues the crystals into calculi. Vaccines have been of no benefit.

DIAGNOSIS

The diagnosis of cystinuria is made by finding cystine crystals in the urine. If a stone is discovered along the urinary tract and no cystine crystals are present in the urine, a diagnosis of cystine calculi cannot be made until the stone is removed. The appearance of cystine stones is characteristic. The history of repeated passing of stones is suspicious of cystine calculi.

CASE REPORTS

The following reports concern three

cases presenting cystinuria and cystine calculi:

Case 1. D. E., a man, aged twenty-nine, was admitted to the Brady Urological Foundation of the New York Hospital February 28, 1927 with a right kidney stone. He complained of pain in the back, hematuria, frequent and urgent urination, and passing of small stones for the past ten years. One brother had previously been operated upon for a cystine stone in the bladder. The remainder of the family had no cystine in their urine and no history of stones. He had been perfectly well and robust with no previous illnesses except that his appendix has been removed ten years previously as a result of the first renal attack. He had passed about 50 small stones which were all soft and easily powdered when dry. A renal colic began with a feeling of depression, followed by hematuria and pain in either the right or left back lasting from four days to seven weeks and ending by the passage of small stones.

Physical examination was entirely normal except for slight tenderness in both right and left costovertebral angles. Urine analysis showed a trace of albumin, sp. gr. 1.021, with blood, pus, and cystine crystals. Blood chemistry:

Coagulation time	4 min.
Urea nitrogen	14 mg. per 100 c.c. of blood
Blood sugar	0.118 per cent
Plasma combining power	(CO_2 tension) 65 vols. per cent

Previous cystoscopy on February 9 revealed a normal bladder and ureters through which No. 6 F. *x*-ray catheters passed to the kidneys without difficulty. Kidney function revealed:

	Rt.	Left
Urea	4/5 gm. per l.	5 3/5 gm. per l.
P.S.P.	App. 6 min.	3 min.
Per cent 10 min	2 per cent	13 per cent
Microscopic	8 w.b.c. per field	Blood
Cultures	Sterile	Sterile

X-ray showed large right and left kidneys in good position with a stone the size of the end of one's thumb in the right kidney pelvis. (Figs. 1 and 2.) A pyelotomy was done March 1, no sutures being used in the kidney pelvis. Recovery was uneventful.

The stone was oval and flattened, measuring 9.5 × 15 × 21 mm. It was rather hard in consistency and when broken it was seen to be made up of light brown translucent large "granules," composed of cystine.

Fig. 9.

He was next seen June 25, 1927 when his right ureter was dilated. On February 23, 1928, he suffered an attack of right renal colic at which time his right ureter was dilated and a large group of cystine crystals were crushed in the bladder. On March 5, 1928, he had pain in his left flank and was unable to void. Catheterization of his bladder released no urine. The left ureter was dilated with a No. 8 F. catheter which released a continuous flow of urine for five minutes. The right ureter was dilated with No. 9 F. bougie on May 12, 1928, June 2, 1928, and June 16, 1928. He was not seen again until February 2, 1929 when he complained of pain in his left kidney region. At this time an attempt to pass a No. 9 F. bougie met an obstruction just below the left renal pelvis. On February 13, 1929, he suffered severe pain, but passed no stone and his urine showed no blood. An attempt to dilate the left ureter encountered an obstruction just above the ureteral orifice and another about half way up the ureter which could not be passed. An *x*-ray showed the right kidney pelvis almost completely filled with stones. (Fig. 3.) There was a questionable

shadow in the region of the left kidney pelvis, but none could be seen along the course of the ureter. Two small stones were passed on

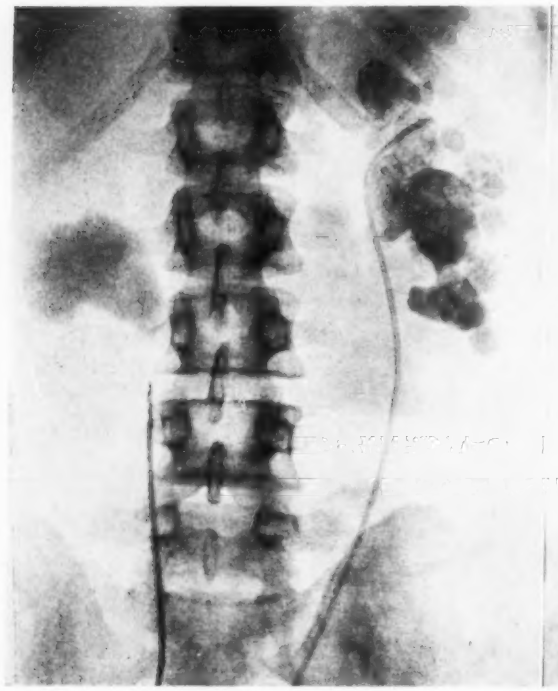


Fig. 10.

Fig. 11.

February 20, 1929 and one large one on April 27. On May 7, 1929 his urine showed a few W.B.C., rare R.B.C., few cystine, and many calcium oxalate crystals. He had taken various amounts of alkalies by mouth but has only been cooperative when in severe pain or urinary retention.

Cystoscopy May 10, 1929 revealed a slightly congested bladder. A No. 7 F. catheter passed to the right kidney easily but it was impossible to pass any catheter up the left ureter. A No. 6 F. bougie passed with difficulty almost to the left kidney. Kidney function showed:

	Rt.	Left
Urea	5 mg. per l.	0.2 mg. per l.
P.S.P.	app. 5 min.	?
Per cent 10 min.	6.5 per cent	2 per cent
Microscopic	18 W.B.C. per H.P.F.	11 W.B.C. per H.P.F.
Cultures	Negative	Negative

X-rays on this date showed that the stones in the right kidney pelvis were somewhat larger in size.

Case 11. E. P., a woman, aged thirty-seven, was admitted to the Brady Urological Foundation of the New York Hospital November 22, 1928 with bilateral kidney stones.

She complained of pain in the right side and pit of her stomach with occasional attacks of renal colic accompanied by nausea and frequency of urination for a number of years. Her family history was irrelevant. During one of these attacks fourteen years ago her appendix was removed. Stones had been removed from both the right and left kidneys five years ago. She was comfortable for almost a year after these operations.

Physical examination revealed a well-nourished, apparently healthy woman with slight tenderness in the right costovertebral angle.

Urine analysis showed a trace of albumin, sp. gr. 1.012, with blood and pus.

Blood chemistry:

Urea nitrogen	11 mg. per 100 c.c. blood
Blood sugar	0.107 per cent
Plasma combining power	(CO_2 tension) 58 vols. per cent

November 22, 1928 Intramuscular P.S.P. 3 per cent—8 per cent—8 per cent—7 per cent—8 per cent. (Half hour specimens.)

Previous cystoscopy on November 1, 1928 revealed slight edema around the ureteral

orifices. No. 6 F. catheters passed easily to each kidney.

Kidney function:

	Rt.	Left
Urea	13 gm. per l.	8 gm. per l.
P.S.P.	app. 9 min.	9 min.
Per cent 10 min	2.5 per cent	2 per cent
Microscopic	pus 28 per H.P.F.	pus 2 per H.P.F.
Cultures	staphylococcus albus	sterile

X-ray plates showed large kidneys with many stones in each pelvis. It was deemed advisable to operate on the right side first because of pain and discomfort. (Fig. 7.)

A right nephrotomy was done November 23 with the removal of one large stone and several small ones. Recovery was uneventful.

Before the patient was discharged from the hospital an *x*-ray showed the complete absence of stones in her right kidney. (Fig. 8.) She was instructed to take 40 grains of sodium bicarbonate three times daily and to test her urine with litmus paper night and morning to be certain it remained alkaline. She was also advised to maintain a low protein diet and to return every two weeks to have her kidney pelves lavaged. She has carried out none of these instructions and in all probability will form other stones in her right kidney.

Case. III. S. H., a boy, aged sixteen, was first admitted to the New York Hospital on November 1, 1917 with pain in the right lower quadrant. This pain began one and one-half years previously with severe cramps which recurred at intervals. There was some tenderness over McBurney's point. His urine contained a few W.B.C. His appendix was removed.

On February 20, 1922 he was readmitted with pain in the left groin, having been awakened at night by a severe stabbing pain. He had some frequency of urination and an occasional W.B.C. in the urine. Cystoscopy revealed a colon bacillus pyelitis but *x*-rays and pyelograms showed no stones. Cystoscopy on February 25, 1924 revealed a calculus in the left kidney pelvis which was only apparent because of a filling defect in the pyelogram.

On admission February 25, 1924 he complained of recurrent attacks of renal colic and a heavy sensation in the kidney region with radiating pains to the penis.

Cystoscopy on this date revealed a patchy cystitis with some pus in the bladder. Catheters No. 6 F. passed to each kidney without difficulty. Kidney function:

	Rt.	Left
Urea	4 gm. per l.	3 gm. per l.
P.S.P.	app. 4 min.	no app.
Per cent 10 min	6 per cent	none
Microscopic	occ. W.B.C.	many W.B.C.
Blood urea nitrogen	22 mg. per 100 c.c.	

Urine analysis showed a trace of albumin with much pus, occasional R.B.C., and cystine crystals.

On March 7, 1924 a left kidney stone was removed through a posterior pyelotomy incision. Small fragments of stone passed out through the wound during convalescence which was prolonged. Dilitation of the left ureter and a retention catheter to the kidney pelvis aided in healing the wound.

On March 28, 1924 a right pyelogram revealed a filling defect opposite the transverse process of the fourth lumbar vertebra. The patient received no further treatment until he was again admitted April 30, 1929. After he was discharged from the hospital in March, 1924, he had considerable pain in his right kidney region. In February 1925, a plain *x*-ray showed a large stone in the right kidney pelvis. For the next two years he had intermittent attacks of pain in both kidneys, but for the last two years he has had no pain except a feeling of weight in both loins. His only other symptom on admission was frequency of urination every hour. There has been no change in his weight.

Cystoscopy on April 30, 1929, showed a slight congestion of the bladder. No. 6 F. catheters passed to each kidney. Kidney function:

	Rt.	Left
Urea	10 gm. per l.	8½ gm. per l.
P.S.P.	app. 13½ min.	app. 3½ min.
Per cent 10 min	none	3½ per cent
Microscopic pus	200 per H.P.F.	pus 200 per H.P.F.

Urine analysis showed a trace of albumin, sp. gr. 1.015 and much pus.

Blood chemistry: May 2, 1929: Urea nitrogen, 24 mg. per 100 c.c. Blood sugar, 0.113 per cent. May 6, 1929: Urea nitrogen, 19 mg. per 100 c.c. May 8, 1929: Urea nitrogen, 13 mg. per 100 c.c.

Plasma combining power (CO_2 tension) 59 vols. per cent.

X-rays taken April 30, 1929 showed multiple calculi in both kidneys as shown in the accompanying pictures. (Figs. 10 and 11.)

Confronted with such a difficult problem it was deemed advisable to do no surgery until we had attempted to dissolve the stones, or to prevent them from becoming larger.

If we could prevent the stones from increasing in size, we might then expect to keep the kidneys from forming new stones, providing the patient lived up to a strict regime. Since cystine stones are soluble in alkalies, we administered large doses of sodium bicarbonate by mouth and irrigated one kidney pelvis with a solution of sodium bicarbonate.

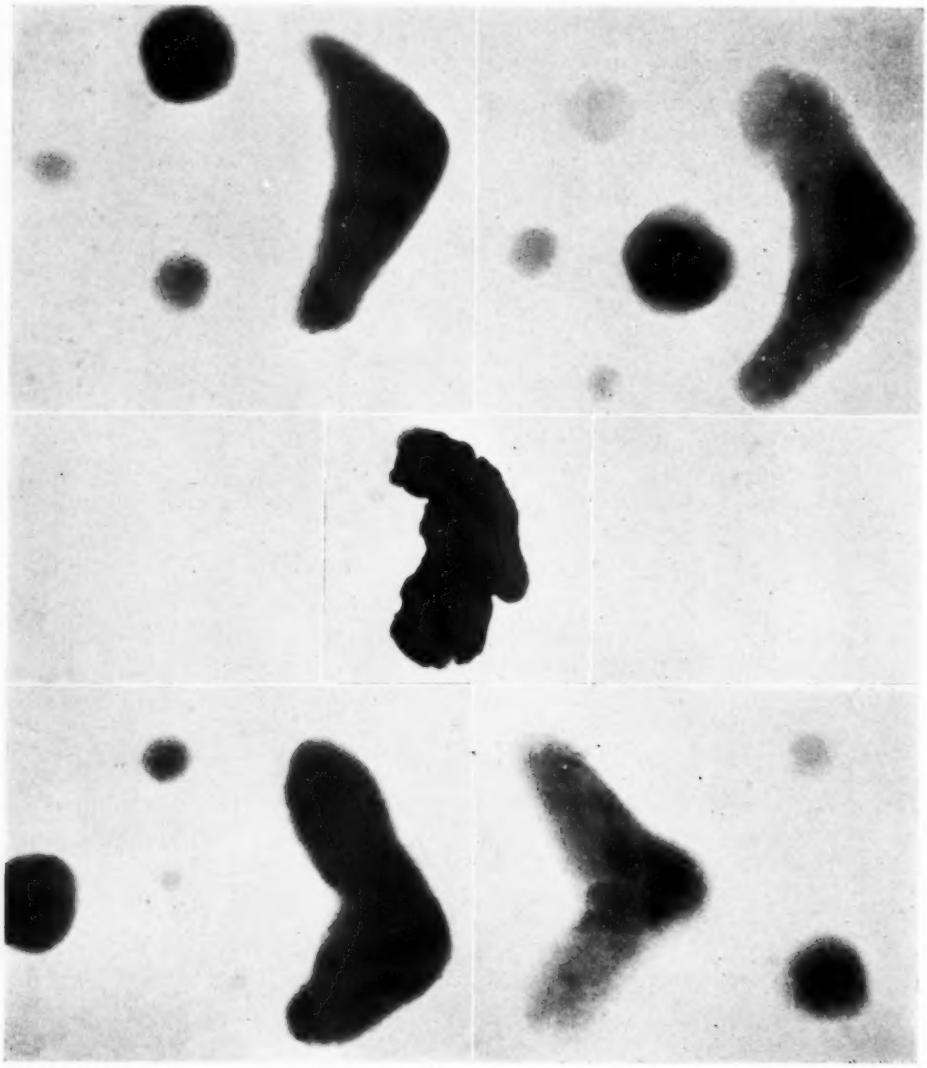


Fig. 12.

On May 6, 1929, No. 6 and 7 F. catheters were both passed to the right kidney pelvis and left in position. Irrigation was begun through the smaller catheter with sodium bicarbonate solution every ten minutes, the solution draining from the kidney through the larger catheter. After ten hours the catheters stopped draining and were removed. Sixty grains of sodium bicarbonate was given by mouth four times daily. A low cystine diet was also given. On the third day the patient developed pain in both kidney regions and showed symptoms of alkalosis. All medication was stopped and the symptoms gradually subsided.

COMMENTS

The results in these 3 cases show how discouraging the usual treatment of cystine stones is. Surgical removal of the offending stone is merely the beginning of the cure of the patient.

Each of these patients had the appendix removed on account of attacks of right-sided pain. Then each had stones removed from one or both kidneys and promptly reformed larger stones with a resulting decrease in kidney function.

The first attack of renal colic was always on the right side. The most common

symptom was pain in the back with history of recurring attacks of renal colic over a considerable period of time. Hematuria has been present in each at one time or another, and a history of passing small stones in the urine is common. Frequency and urgency of urination is probably the result of the infection which is always present, and probably plays an important rôle in the formation of the stones.

Strangely enough the family history of each has been irrelevant and we have been unable to find cystinuria in any other member of the families except one brother of D. E. Each of the patients has had unusually good health all his life except for the formation of these cystine stones. There has been no venereal history in any of them.

Cytoscopic examinations have shown very little pathology in the bladder. Stones have either passed entirely, or have remained in the kidneys. A kidney containing a stone showed no function at one time, and after removal of this stone, this same kidney later on was doing all the work. Urine cultures have shown definite infection in each case. Blood chemistry examinations have been normal even when both kidneys were embarrassed with large stones. The longest expectancy for relief after surgery alone is one year.

Plain *x*-ray pictures have shown the stones in all cases eventually. However, in Case III, repeated *x*-ray and pyelograms failed to reveal the presence of a stone until it had reached considerable size. Even then the stone was first discovered by a filling defect in the pyelogram. Cystine has been variously estimated to contain from 25 to 75 per cent of sulphur. We have prepared an *x*-ray of a cystine stone, plain starch paste, and starch paste with 5, 15 and 25 per cent sulphur, to show the various densities obtained. (Fig. 12.) It is apparent that any stone containing 25 per cent sulphur should cast a shadow sufficient for diagnosis.

TREATMENT

Patients suffering from cystine calculi must be treated medically as well as surgically. The preoperative diagnosis and the postoperative care are more important than the mere removal of the stone.

Before considering an operation, the condition of the ureter and kidney must be determined. An obstruction in the ureter or a ptosis of the kidney may be remedied at the time of operation. To expect the kidney to remain free from stones, one must be certain that good kidney drainage is established. If a stricture of the ureter is present it should be dilated. A nephropexy can be done on a ptosed kidney at the time the stones are removed. Chromic catgut should not be used in the kidney.

It has been established that cystine crystals are either dissolved or disintigrated in an alkaline media. Therefore sufficient sodium bicarbonate should be given to render the urine alkaline and keep it alkaline. The urine can easily be tested morning and night by the patient himself. Potassium bicarbonate, ammonium bicarbonate or other alkalies may be used if sodium bicarbonate is not well tolerated. Sixty grains of sodium bicarbonate three times daily is usually well tolerated and sufficient to keep the urine alkaline.

Infection of the kidneys must be combated. Urinary antiseptics which are active in alkaline urine should be given at intervals. Pyridium may be used for this purpose. Dilatation of the ureters and irrigation of the kidney pelves with an antiseptic solution is of value.

The gastrointestinal tract should be carefully regulated. Salol may be given for one week of each month.

A low cystine diet should be adhered to. Some proteins contain much cystine and others very small amounts. Milk, nuts, beans, peas, bread, eggs, meat and fish contain large amounts of cystine and should never be permitted. Gelatine, cheese all fruits, all vegetables (except peas and beans), butter, cream, jellies and jams, corn bread or corn cereal (sparingly) contain small amounts of cystine, yet sufficient protein to maintain normal metabolism.

CONCLUSIONS

1. Cystine calculi are medical as well as surgical problems.

2. Cystine stones recur so frequently and quickly that all means at our disposal should be used to prevent this. The probability of stones reforming should be impressed on the patient, who must cooperate in every respect.

3. Cystine stones usually cast a shadow in *x*-ray pictures. Small stones may cast no shadow.

4. Treatment consists of:

(1) Establishing perfect kidney drainage.

(2) Keeping the urine *continuously* alkaline.

(3) Urinary antiseptics.

(4) Ureteral dilatation and kidney pelvic lavage.

(5) Gastrointestinal antiseptics.

(6) Low cystine diet.

I wish to take this opportunity to thank Dr. Lowsley, Dr. Butterfield, and Dr. Seward Erdman for permitting me to report these cases. I also wish to thank Dr. Frederick B. Henschel for helping prepare this paper and for many helpful suggestions.

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CANCER OF THE LIP AND BUCCAL MUCOUS MEMBRANE*

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HAMLET, N. C.

PROBABLY no field of malignancy has proved so hard to deal with successfully as that where the growth involves the lip or the buccal mucous membrane. A cancer of the lip at or within the mucocutaneous junction presents the same conditions which make it as resistant to the various methods of treatment as one located well within the buccal cavity. Both are bathed with saliva, are irritated constantly by the tongue rubbing over them, and cannot be immobilized to any degree on account of the activity of the facial muscles. If the growth is located on the lip without the mucocutaneous junction and does not infiltrate into the substance of the lip deep enough to involve the small libial glands, it well respond readily to radium exposures. When there is involvement of the mucous membrane or where the growth is bathed with saliva, we have found that the condition is very refractory to treatment by means of surgery, *x*-rays, and radium, or a combination of these methods.

Formerly, it was customary to remove these cancers by surgical operation, the dissection being made about ½ inch from the carcinoma, in uninvolved tissue. After this block removal, the edges of the wound were sutured with silkworm gut. Carcinomata of the lip and buccal cavity show a tendency to metastasize early; therefore the fat and glands of the submental and submaxillary regions were removed at the time of operation. The precaution to remove the fat and glands of both sides of the neck, even though the carcinoma was distinctly to one side of the median line, was because of the cross lymphatic drainage of this area. According to DaCosta,[1] the submental, submaxillary, and cervical lymphatic glands are usually involved within three months of the beginning of the cancer. He cites a case of his own where they were found to contain carcinoma cells in less than three months after the origin of the carcinoma of the lip. "This involvement cannot be detected by external manipulation in the earliest stages, hence it is not proper to conclude that glandular involvement is absent simply because it cannot be palpated."

FIG. 1. FIG. 2.

FIG. 1. Case 1. Epithelioma of lower lip before treatment.
FIG. 2. Case 1. Well after seven years.

[1] DaCosta, J. C. Modern Surgery. Ed., Phila., Saunders, 1917, p. 923.

* Read before the Fifth District Medical Society of North Carolina, Sanatorium, N. C., April 27, 1923. Submitted for publication July 18, 1929.

With the advent of the *x*-rays and radium in the treatment of malignancy, it was thought that these cases would respond to these measures. It has been our experience that cancers of the lip and the buccal cavity are very resistant to radium and *x*-rays, in fact, that the results are not at all satisfactory. As already mentioned, if the growth is on the lip and removed far enough from the mucocutaneous junction that it is not kept moist with saliva and is not rubbed by the tongue, it will usually be cured with exposures to radium.

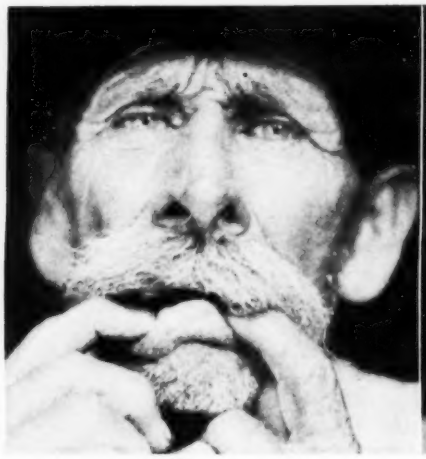

Fig. 3.

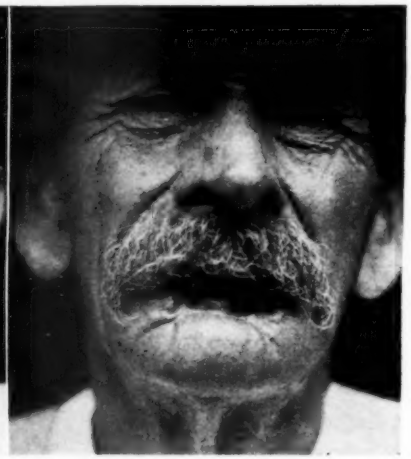

Fig. 4.

Fig. 3. Case 11. Epithelioma of lip.
Fig. 4. Case 11. Electrosurgical removal.

Our method of handling these cases is to remove the cancerous area by electrocoagulation, using the technic of Dr. W. L. Clark, of Philadelphia. The machine is a high-frequency outfit, producing damped currents for dehydration and coagulation. The tissues for about 1 inch about the carci-

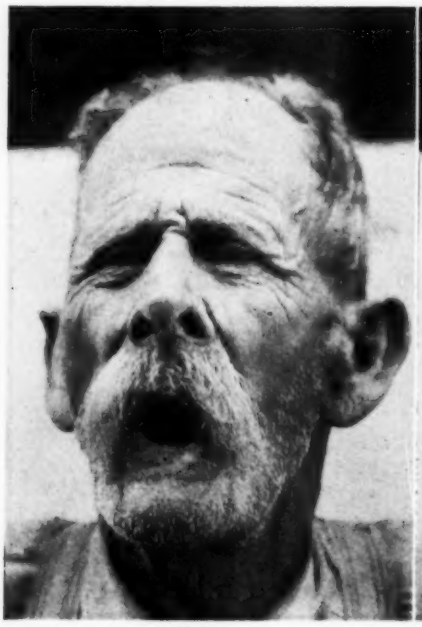

Fig. 5.

Fig. 6.

Fig. 5. Case 11. After plastic operation. Two incisions were made, one on either side, 1½ in. from medium line and parallel with each other, lip was lifted and deformity repaired with result shown in Figure 6.
Fig. 6. Case 11. Well.

noma are blocked with a 1 per cent solution of novocaine. Using the bipolar d'Arsonval current, with the patient reclining on the body electrode, which is 18 × 36 in. in size, the operating electrode is inserted into the normal tissues at a distance of ½ inch from the carcinoma at intervals of ⅛ inch until the growth is circumscribed. The electrode enters the tissue to such a depth that the operator is sure that he has gone well beyond the base of the cancer. In the removal of a cancer of the lip, the electrode is first inserted from the external aspect for a distance about two-thirds of the way through the lip, in a crescentic line about the cancer and at a distance of ½ inch from it. Then the lip is everted and a like procedure

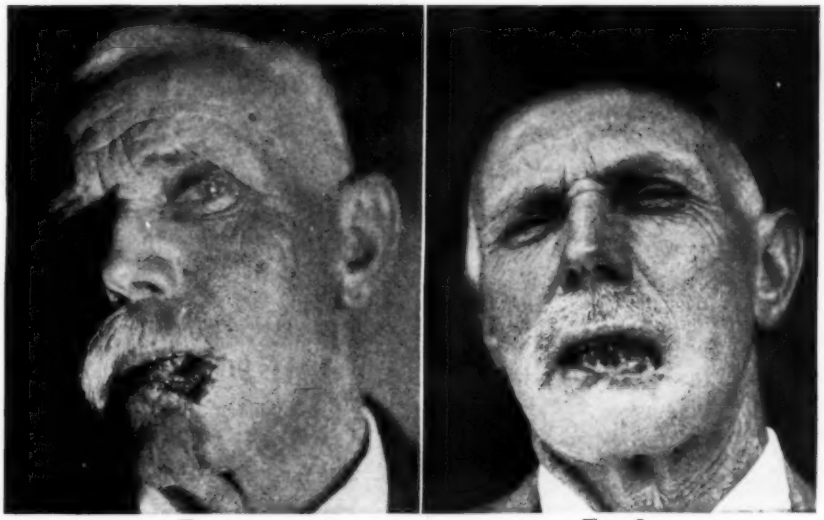

Fig. 7. Fig. 8.

Fig. 7. Case III. Epithelioma of lip.
Fig. 8. Case III. After operation.

Fig. 9. Fig. 10.

Fig. 9. Case IV. Epithelioma destroying upper lip and part of nose.
Fig. 10. Case IV. Same after electrosurgical removal.

on the inside of the lip is carried out. If the cancer is within the mouth, for example on the inside of the cheek, the same procedure is done of inserting the electrode into the normal tissues all around the cancer to the desired depth. Then the electrode is inserted into the cancer itself at short intervals until the whole mass is desiccated out to the line of circular coagulation. The mass of tissue which has been coagulated is then lifted up with tenaculum forceps and removed with a sharp scalpel, the line of incision following the line of coagulation. There is no hemorrhage, as the blood vessels and capillaries have been sealed off by the coagulation process.

Fig. 11. Fig. 12.

Fig. 11. Case v. Patient treated with radium for small cancer of lip about five years ago by author. Three years ago one-half of lower jaw was removed by another surgeon. Four weeks ago electrosurgical removal by author.
Fig. 12. Case v. Four weeks after operation. Lesion practically healed. No evidence of lingering growth.

A word should be said here in explanation of what the coagulation method is. It must not be confused with any process of cauterizing or burning. At all times the operating electrode is of the same color and remains at room temperature, even though the milliamperage being used is sufficient to devitalize bone or cartilage. As this process is one of direct diathermy, a certain amount of heat will be generated in the tissues to which the operating electrode is applied. This heat generated within the tissues will in turn raise the temperature of the electrode to a small degree, but it never becomes hot. Immediately upon removal from contact with the tissue, it may be felt as slightly warm. Emphasis is laid upon this fact, for many has a mistaken idea about electrocoagulation treatment of neoplasms, thinking that it is synonymous with cauterization. After the area is coagulated it does not present a blackened or charred appearance. The operating electrode, though a blunt instrument, is pushed readily through normal tissue and leaves a blanched, pearly, coagulated zone for ¼ inch upon each side. When the mass of coagulated tissue, including the malignancy, is excised with a sharp knife, there is not a particle of oozing or bleeding along the line of incision. The blood vessels, capillaries and lymphatics are sealed off by the coagulation.

We do not think it advisable to dissect out and remove the fatty tissue and glands of both sides of the neck. The lips, face and buccal cavity have a very abundant lymphatic supply. In view of this fact, it is not wise to remove a few glands and not be sure that all are removed, because the resulting chances of rapid metastasis from the stirring up of cancer cells over a

vast network of lymphatics are too great. The close relation of the lymphatic glands of the submental and submaxillary regions with the lymphatic glands of the superficial and deep cervical lymphatic chains is too likely to cause rapid metastasis if surgical measures are instituted as a safeguard against recurrence of the carcinoma in the neck. The anterior neck area from the inferior maxilla to the clavicles is treated preoperatively and postoperatively with heavy doses of radium and *x*-rays, in the hope of destroying the embryonal cells of a microscopic metastatic growth before it is large enough to be palpated. All scalpel surgical procedures in cancer of the lip and cancer of the buccal mucous membrane are contraindicated. The matter of excision of the coagulated area is the removal of devitalized tissue for the comfort of the patient, because it would slough away in a few days.

A CONVENIENT MARKER FOR THYROID INCISIONS*

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GREENVILLE, S. C.

I HAVE found that bismuth-violet is excellent for marking the line of incision for thyroid operations. The trial necklace in place, the proposed incision is outlined with the dye. When it has dried, painting the field with dilute tincture of iodine or 5 per cent alcoholic solution of picric acid will not obliterate the mark. It remains a black line easily distinguished. If alcohol alone is used to sterilize the skin, the mark may be obliterated, but not completely so. Though indistinct, enough of the dye may remain to identify the line of incision.

Bismuth-violet is the antiseptic dye recently described by Drs. Barksdale and Wilkinson.[1]

[1] *Southern M. J.* November, 1928.

* Submitted for publication September 6, 1929.

MASSIVE DIAPHRAGMATIC HERNIA WITHOUT DIAGNOSTIC SYMPTOMS*

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UNTIL recent years, diaphragmatic hernia has been more or less of a curiosity and most often found at autopsy. This condition has been more frequently recognized since the advent of the *x*-ray, and during and since the World War, this type of hernia has been fairly common. It was met with often because of the many abdominal and chest wounds which occured, leading to a more widespread knowledge of this condition and to a greater opportunity for close study of the traumatic type in particular.

Diaphragmatic hernia has been defined as "the protrusion of any of the abdominal viscera into the thoracic cavity through either a congenital or an acquired opening." Most authorities divide diaphragmatic hernias into the following types, based upon Richards' classification:[1]

I. True hernias:
   (a) Congenital
   (b) Acquired
   (c) Traumatic
   (d) Non-traumatic.
II. False hernias:
   (a) Congenital
   (b) Acquired.
III. Eventration of the diaphragm.

The true hernia has a covering consisting of either pleura or peritoneum or both. The congenital type exists from birth, the acquired cases herniate through a natural opening, while the traumatic and non-traumatic do not occur through a natural opening.

The false hernias are without sac or covering and constitutes 90 per cent of the total. Embryonic development of the diaphragm predisposes to formation of both true and false types of diaphragmatic hernias at certain sites. Definite knowledge is not yet established as to what factors are at work to prevent proper closure of the esophageal, aortic or vena caval openings. It has been claimed that the aortic and vena caval openings are never the seat of hernia because of their anatomical position and protection. The esophageal cases usually herniate posterior to the esophagus. Occasionally herniation occurs through the space of Torrey or the foramen of Bochdalek; more rarely it has occurred after absorption of a large gumma of the diaphragm. The false acquired hernias are all traumatic and usually result from crushing injuries of the abdomen, back, or thorax, from stab wounds or other trauma. Because of these factors the acquired types are usually found in males and the congenital types are found to be equally divided between the two sexes.

Avulsion of the diaphragm from its costal attachment, either complete or incomplete, may be classed under the acquired false hernias. Eventration, properly speaking, is not a hernia at all, but simply a thinning-out of the dome of the diaphragm with the formation of a pouch to receive the extruding viscera.

The greatest number of cases of hernia reported in the literature occurred on the left side for all types because this side offers an easier exit for the abdominal viscera and herniation is facilitated by the negative pressure in the thorax and the positive pressure existing in the abdomen. Hernia is given by the various authors as occurring from six to twelve times[2] as often on the left side as on the right side. It is reported to be eight times as frequent on this side by Unger and Speiser,[3] who also stated that every abdominal viscus except the genital organs and rectum had

Note: Published with permission of the Surgeon General, U. S. Army, who is not responsible for any opinion expressed or conclusions reached herein.

* Submitted for publication July 18, 1929.

been discovered at least once in the thoracic cavity. The organs which are most frequently encountered in the order of their occurrence are: stomach, colon (50 per cent) omentum, intestines and spleen.

The right side is protected by the liver below and the right lung above in addition to the thick crus diaphragmatica. Sezary and his co-workers[4] report an unusual right-sided hernia where a short loop of the hepatic flexure herniated into the thorax by passing in front of the liver through the ventral portion of the diaphragm due to the absence of fasciculi normally attached to the sternum and costal cartilages. This case was a true hernia exhibiting a sac.

Hedbloom[5] in 1915 made a study of 19 cases of diaphragmatic hernia treated in the Mayo Clinic and 359 found in a comprehensive search of the literature. Two-thirds of the reported cases occurring in civil life were due to penetrating wounds or rupture of the diaphragms by suddenly increased pressure. One-sixth were congenital and one-sixth acquired. In a large percentage, hernia was recognized only after symptoms had been present for many years.

Symptomatology of diaphragmatic hernia varies according to the site of the opening in the diaphragm and the organs or number of organs involved. In the traumatic type there is usually displacement of thoracic viscera by the abdominal organs which have escaped into the thorax. There is commonly dyspnea, cyanosis and disturbed heart action. A tympanitic note may be elicited over the thorax, which may be bulging. Gurgling or sounds of peristalsis may be heard and vomiting and other symptoms of obstruction may be present. Association of hernia of the diaphragm with crushing injuries of chest and abdomen should always be borne in mind. Penetrating wounds of the diaphragm are usually associated with gunshot or stab wounds of abdomen or thorax.

Treatment of diaphragmatic hernia, when any treatment is indicated, is operative, and, based upon the many reports in literature, the sooner the operation is performed the better the prognosis

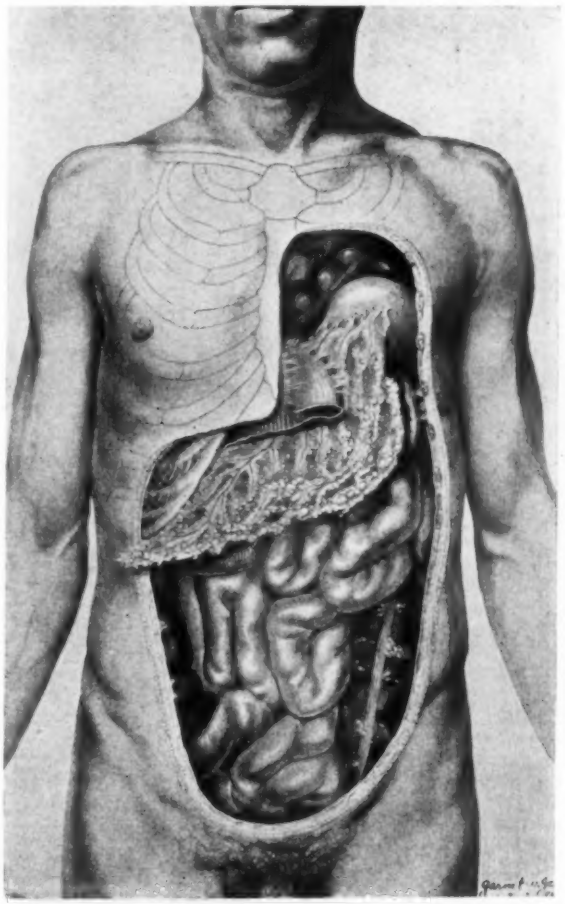

Fig. 1. Case 1. Great omentum, coils of intestines and spleen shown high up in chest and densely adherent. Diaphragm was adherent to transverse colon and to omentum.

and this is particularly true of hernias ensuing after stab wounds or gunshot wounds of the thorax and abdomen. The route of approach may be abdominal, thoracic, or combined. The last is particular useful where the hernial opening is large and contains numerous viscera. The mortality over a period of years has been high, varying from 60 per cent for the thoracic approach to 80 per cent for the abdominal. However, a preoperative diagnosis of diaphragmatic hernia was made in a comparatively small number of cases, the operation usually being performed for intestinal obstruction and hence the high mortality

rate. A preliminary cecostomy to relieve the obstruction as suggested by Truesdale[6] should reduce this mortality somewhat.

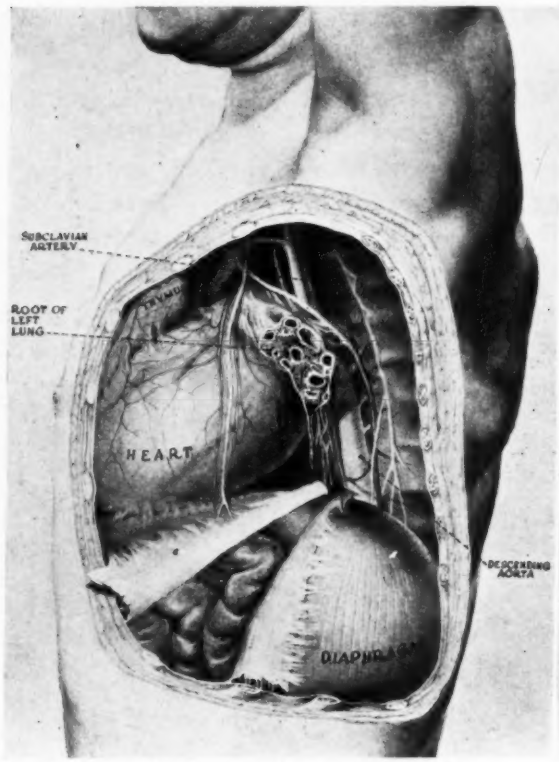

Fig. 2. Case 1. Diaphragm split anteroposteriorly and curled back and adherent to itself.

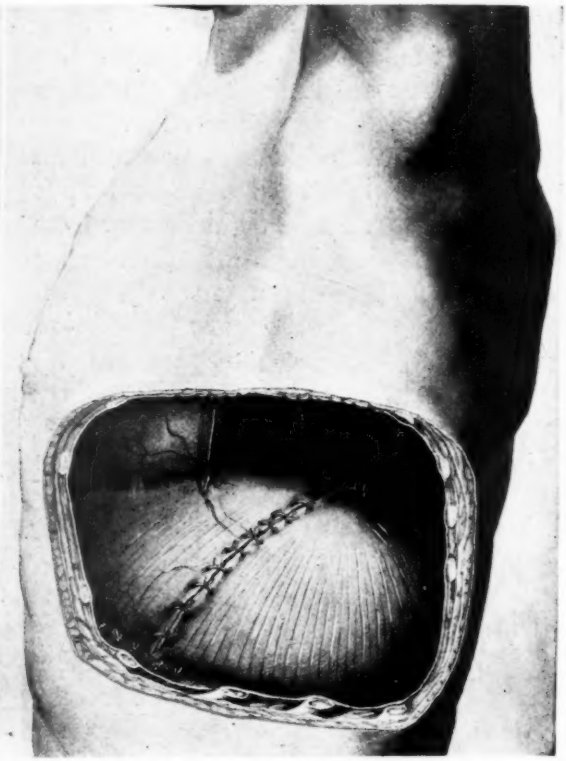

Fig. 3. Case 1. Showing how edges of diaphragm were brought together with interrupted sutures of heavy chromic catgut.

The site of constriction in these obstruction cases has usually been found in the transverse colon, even if the stomach and small intestines has also passed through the opening. Phrenicotomy, by diminishing the lung capacity, may be useful in cases where great difficulty is experienced in returning the viscera to the abdomen and repairing the rent in the diaphragm.

The following case demonstrates how easily this condition may be overlooked even when *x*-ray examination is made. It accents the importance of examining these cases in the prone position. Gastrointestinal symptoms were absent throughout and there were few symptoms referable to the chest. It also illustrates the improbability of incarceration occurring in these large openings and shows the extreme difficulty which may be experienced in suturing the diaphragm to the chest wall as has been reported by Bryan[7] in his case of complete evulsion from the left chest wall.

Case 1. C. P. G., a soldier, aged nineteen, was admitted to Walter Reed General Hospital, August 10, 1921, complaining of pain in the back when he stood long or walked far. Present illness began March 21, 1921, when he was at work at Gatun, Panama Canal Zone, digging dirt from a bank which caved in, burying him beneath the falling earth. He was admitted to a local hospital with a diagnosis of fracture, simple, second and third lumbar vertebrae, *x*-ray examination showing a crushing fracture of the bodies of these vertebrae with marked kyphosis.

In addition he had almost complete paralysis of both lower extremities. By June, 1921 there was marked improvement and he then had good use of his legs except for a slight spasticity and weakness. There were no gastrointestinal symptoms.

Physical examination upon admission was essentially negative except for marked kyphosis in the region of the second, third, and fourth

lumbar vertebrae. The lungs were reported negative. A plaster body cast was applied and after one month a brace was substituted.

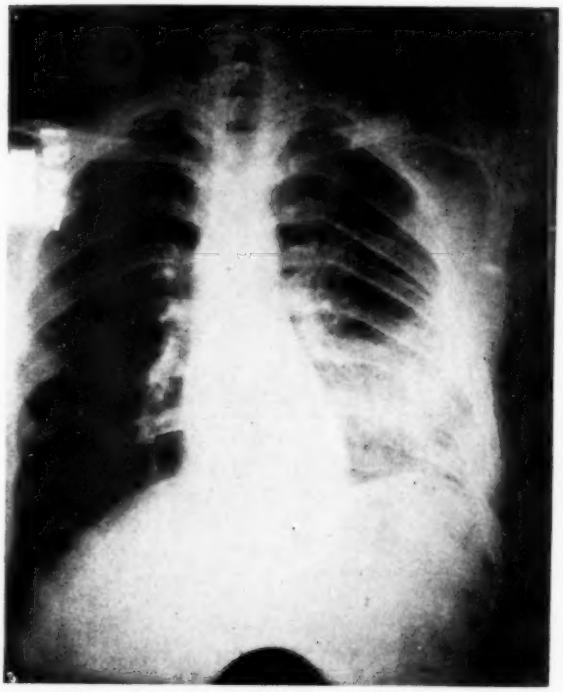

Fig. 4. Case 1. *X*-ray examination following operation showing dome of left diaphragm smooth in outline.

Upon return from a three weeks' furlough in October, he was examined with the view to discharge from the service on account of physical disability. It was then found upon examination of the chest that a tympanitic note was obtained on percussion of the left chest from the fourth rib downward anteriorly and in the left axillary region. Over this area borborygmus was marked. Heart sounds were distant but regular, *x*-ray examination of the chest showed the right lung field clear, and the right diaphragm and costophrenic angle normal. In the left chest from the level of the third rib anteriorly downward the lung field was obscured and no bronchial markings were seen. The diaphragm could not be outlined. In view of possible diaphragmatic hernia, a gastrointestinal series was made. This showed the esophagus normal, the stomach high and apparently in the thoracic cavity extending to the level of the eighth rib anteriorly on the left side. The stomach outline showed a circular constriction at the junction of the lower and middle thirds, the barium passing through a small tunnel connecting the two portions. The meal entered the upper part and practically emptied the lower portion when the patient was recumbent.

Fig. 5. Case 11. Loop of colon extending above diaphragm to level of second rib.

On standing the lower portion filled. The transverse colon entered the chest cavity and extended to the level of the seventh rib in the axillary line. Fluroscopic examination showed that the stomach and colon pierced the diaphragm and entered the thorax posteriorly and externally to the apex of the heart.

On January 26, 1922, the patient was operated upon by the thoracic approach. Incision was made in the seventh interspace on the left side and extended from close to the angle of the ribs posteriorly to the anterior axillary line anteriorly. The seventh and eighth ribs were divided at either extremity of the incision and the intercostal muscles cut through and ribs turned up and down. The great omentum and coils of intestines presented which when pushed aside showed what appeared to be a complete absence of the diaphragm and the hand was easily introduced into the abdominal cavity. The spleen was seen high up in the chest to the outer side, densely adherent to the chest wall and to the torn margin of the diaphragm, which was also adherent to the transverse colon and to the omentum. (Fig. 1.) The viscera were dissected

free and easily returned to the abdomen. The diaphragm was split across its fibers anteroposteriorly and was torn away from its attachment to the chest wall about 1 inch posteriorly and about twice that distance from the anterior wall. The inner side of its anterior attachment was torn away for a distance of 1½ inches on each side of the rent. This formed a quadrilateral-shaped flap which was curled back and adherent to itself. (Fig. 2.) The bands of adherent connective tissue were divided and the edges brought together with interrupted sutures of heavy chromic catgut. (Fig. 3.) The greatest difficulty was experienced in suturing the diaphragm to the chest wall.

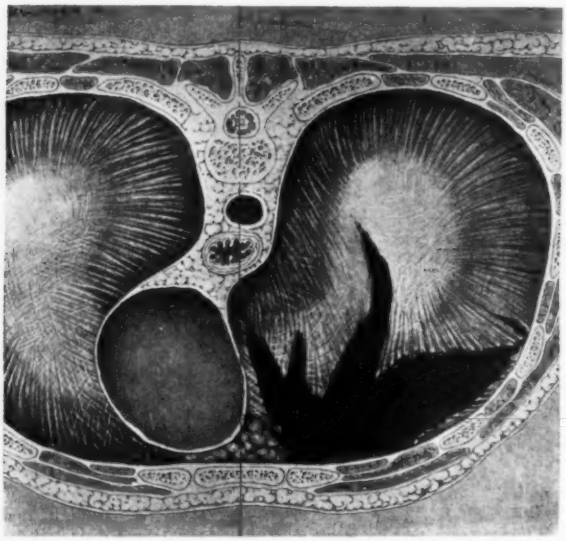

Fig. 6. Case 11. Large ragged rent in diaphragm which was torn in at least three directions.

The patient made an uneventful recovery and *x*-ray examinations one month after the operation showed stomach and colon in normal position within the abdomen and no defects or abnormalities demonstrable. The dome of the left diaphragm was smooth in outline but limited in its excursion. (Fig. 4.)

The next case again illustrates how diaphragmatic hernia can be overlooked in spite of *x*-ray examination and how necessary it is to examine these cases after ingestion of an opaque meal in both the upright and prone positions. This case was of long standing and shows how difficult it may be to return the viscera to the abdomen successfully and to repair the rent in the diaphragm. In this case the symptoms present were predominantly referable to the chest.

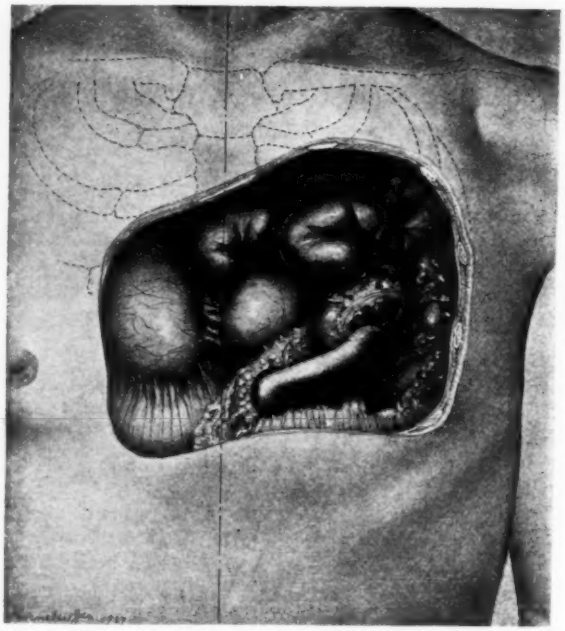

Fig. 7. Case 11. Stomach, loop of colon, spleen and portion of small intestine protruding into thorax through rent in diaphragm.

Case 11. A. S., a soldier, aged forty, was admitted to Walter Reed General Hospital, December 2, 1925, complaining of pain in the left shoulder, shortness of breath, especially at night, and cough. He stated that in November, 1918 he was kicked in the left chest by a mule and almost immediately developed a cough which had persisted up to the time of admission. Following the kick he was sick in quarters for one week when he returned to duty which he continued to perform until 1923, when he was admitted to hospital with a diagnosis of left pleurisy with effusion. *X*-ray examination at this time showed a marked increase in density extending from the fourth interspace to the base on the left side, obliterating all lung markings. There was a dense band, apparently pleural adhesions, extending across the chest at the level of the fourth rib. The heart was displaced to the right.

After five months' observation the patient was transferred to another hospital for the treatment of pulmonary tuberculosis from which he was later again returned to duty. He did special duty as a saddler until the expiration of his enlistment. He re-enlisted

but was unable to do much duty and was sent to Walter Reed General Hospital for treatment. Physical examination at the same time of admission was essentially negative except for the chest. The heart was not enlarged, sounds were normal, but it was displaced to the right. Examination of the chest showed tactile fremitus diminished over the lateral aspect of the left chest. The percussion note was increased and the breath sounds and spoken voice sounds were greatly diminished over the outer aspect of the left lung. *X*-ray examination of chest showed marked displacement of the heart to the right. The right lung was negative. The right diaphragm was smooth and the left dome elevated. There were two large gas bubbles in close relation to what appeared to be the inferior surface of the diaphragm. Examination with the opaque meal showed the above shadows to be in the stomach and colon. In the upright position they ascended so that a part of both viscera was above the diaphragm. The funds of the stomach reached to the level of the second rib anteriorly. A long loop of colon appeared above the level of the diaphragm and reached to the level of the second rib. (Fig. 5.) In the prone position the outline of the diaphragm was not definitely shown. The stomach emptied in six hours.

On December 31, 1925 the patient was operated upon through an incision in the seventh interspace extending from anterior to posterior aspect of the chest. The seventh and eight ribs were sectioned to permit easier access to the cavity. A large rent about 5 inches in diameter was found in the diaphragm. (Fig. 6.) Through this rent protruded the stomach, a loop of colon, spleen and a portion of the small intestines. (Fig. 7.) The stomach and the colon were adherent to the mediastinum. After freeing the stomach and colon these vicera were replaced with difficulty in the abdominal cavity. Attempt was made to repair the rent in the diaphragm. This rent was ragged in outline, the diaphragm being torn in at least three directions and after drawing the edges together there still remained an opening nearly as large as the palm of the hand, which could not be approximated. A portion of the latissimus dorsi was brought inward from the thoracic wall and the defect closed by this muscle flap. (Fig. 8.) Before closing the chest the lungs were inflated by positive pressure. At the completion of the operation it was noted that the intra-abdominal pressure had been markedly increased due to the replacement of the abdominal viscera which had been so long outside their natural cavity. The patient left the operating room in good condition. The day following operation *x*-ray of the chest

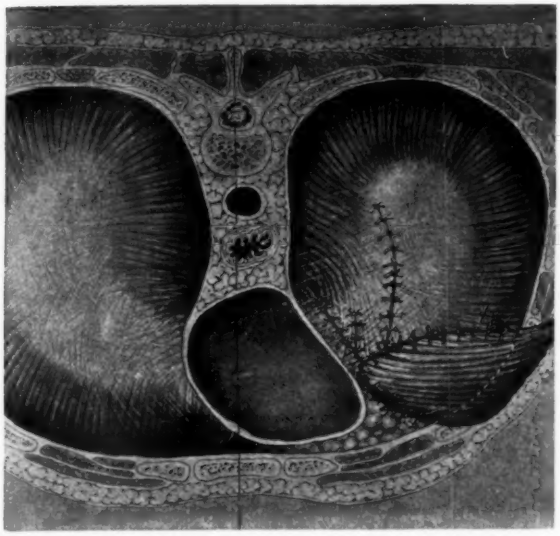

Fig. 8. Case 11. On approximating rent in diaphragm, defect remaining was closed by bringing inward from thoracic wall a muscle flap from latissimus dorsi.

Fig. 9. Case 11. *X*-ray following operation showing muscle flap in place completely obliterating defect in diaphragm.

showed the muscle flap in place completely obliterating the defect in the diaphragm. The costophrenic angle was clear. (Fig. 9.) In the afternoon the patient's abdomen became distended and tense. All efforts to move the bowels failed and under local anesthesia an enterostomy was done and a Bonney tube inserted in a loop of ileum. The day after the enterostomy the patient began to manifest symptoms of tetany. The convulsions persisted in spite of every treatment, gradually becoming stronger and of longer duration until the next evening when death ensued. Autopsy showed all sutures intact. There were about 500 c.c. of a bloody exudate in the left pleural cavity and a fibrinous pleurisy of both lungs with some plastic exudate on the left. The upper half of the small intestines were distended and the lower half were empty. A preoperative phrenicotomy would have aided materially in the closure had the magnitude of the condition been suspected.

In conclusion it is desired to stress again a point which has been emphasized many times before and that is that massive diaphragmatic hernia in a large majority of cases is recognized only after it has existed for a long time. Objective and subjective symptoms may be few and there may be little in the history of a given case to suggest the presence of such a condition.

Diaphragmatic hernia will continue to be overlooked unless careful *x*-ray examination is made including examination by means of the opaque meal with the patient in the upright and prone positions.

These cases show the improbability of incarceration with its attending intestinal obstruction and the difficulty sometimes encountered in repairing the rent in the diaphragm.

The part played by crushing injuries and external violence in causing this type of hernia should always be borne in mind.

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TRAUMATIC SPONDYLITIS*

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NEW YORK

FOLLOWING trauma many patients develop symptoms of a back disability equivalent to a spondylitis. In spite of repeated examinations, from the symptoms the patient presents we are unable to make a diagnosis other than spondylitis and by this we mean that there is a sensitiveness of the joints of the back, usually the lumbar spine. His complaints and the way of handling himself correspond to a general spondylitis of a mild inflammatory character and the essential complaints are pains in the back, a weakness or inability to use his back and a spasticity of the spine which acts like a reflex spasm. The pains may not be referred to definite locations; they are usually fairly general and are not diagnostic in themselves. The spasticity is not a fixed condition; it is possible to secure relaxation and motion in recumbency and the weakness as in cases of sprain is not real but simply an inability to use the muscles without causing increased reflex spasm and pain. The roentgen-ray findings are essentially negative showing the degree of bone ossification corresponding to the age, congenital anomalies and unevenesses which we know the patient has had without symptoms.

When the symptoms allow of a more definite diagnosis on an anatomical basis we can improve on our nomenclature. The essential elements of this group, however, do also apply to cases with an interesting anatomical lesion whose diagnosis after all depends upon our fortunate ability to gain concrete evidence of a condition which in itself cannot explain the patient's general condition, such as fracture of a rib or tip of a lateral process. When we speak of this condition as a spondylitis we bring to each other's mind a definite clinical syndrome and the terminology is therefore justified. A true spondylitis it is not. Only very rarely is traumatism alone the cause of an inflammatory reaction in the spine such as we can demonstrate readily following other joint fractures. Slight impactions of vertebral bodies may occur but if the *x*-rays are not definite we have no right to make a diagnosis of a serious lesion. I say serious mainly because so many of the cases are known to run a prolonged chronic course. All sorts of lesions do occur but when we resort to the term traumatic spondylitis we denote the absence of objective signs leading to a more definite diagnosis. This symptom complex can best be analysed in three factors:

1. The traumatic condition which is equivalent to a back sprain.

2. The inflammatory, which may be said to be present in all of us and which is a reaction of the tissues and largely dependent on our local sensitiveness and preexisting arthritis.

3. Lastly and more important: the psychic; for it is through this that the symptoms of the organic conditions are expressed and amplified. These factors are very hard to separate, are inherent in the patient and give ground for considerable difference of opinion. It is by a clinical study of these cases that we must value relative importance of these elements.

THE TRAUMA

Back sprains are usually induced by indirect violence. Lifting and falling are the most common causes. Torn ligaments and fascia, internal bruising, ecchymosis and edema are the local lesions. When a bone lesion exists we dignify it with a more concrete diagnosis. It is impossible to demonstrate joint separations, such as a theoretical sacroiliac relaxation or tears of other ligaments of the spine. A sprained

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back certainly does occur the same as any other joint sprain and may result in a permanent weakness, but it does not adequately account for most of the clinical picture. We must also consider the possibility that we are dealing with a case that turns out to be a "Kummell," post-traumatic vertebral body absorption. In these cases after a fairly brief disability due to the trauma itself a second stage of comparative recovery sets in during which the patient may even go back to work. This is followed after weeks or months by a collapse of vertebral body with a kyphosis and all the secondary symptoms of a spinal fracture, that is, the localized pains and disability. There is an inflammatory reaction. It is this clinical possibility that prevents us ruling out an organic lesion and encouraging our patients with the certainty of its non-existence. If this condition exists in lesser degrees than a frank collapse we have no means of diagnosing it. We cannot make out the post-traumatic inflammatory reaction without *x*-ray changes as an objective sign.

I have purposely omitted a discussion of the effects of concussion on the central nervous system. Whether the underlying condition is more or less organic does not change the objective.

INFLAMMATORY REACTIONS

Joint and fascial sensitiveness occurs as a fixed condition in many people. Throughout life they have attacks of real pain in and about joints and although apparently not neurotic or hysterical are readily cured of these pains. Their tissues are more sensitive and more easily inflamed. The tissues may be synovial, peri-articular, fascia, bursa, in fact any tissue well supplied with nerves of pain.

Today we are finding more of our arthritics harboring infections and possibly we will come to the conclusion that low-grade infection may be present in our body tissues as in our intestinal canal with non-pathogenic organisms causing no gross changes. After a trauma and a destruction of the tissue the local reaction changes, the bacteria gain a foothold and an inflammation ensues. If this reaction is present in a very large percentage of all people, I feel we will have to call it physiological. The liability to reaction after trauma is not entirely pathologic.

With age, sclerotic changes may be demonstrated in joints, as in arteries. These productive or sclerotic changes progress silently; there is less elasticity and the tissues are less able to repair after injury. Mild spondylitis deformans is common in people without symptoms. Injury to such a joint would be more liable to cause an inflammatory reaction.

PSYCHIC REACTIONS

The normal psychic reaction of a person to a trauma is that which will occur in 80 per cent of all people. It is in the recovery that the differences between cases will show themselves most. The stronger recover more completely and the psychically weaker continue with their ailment. The stronger face realities and answer the situation. The weaker delay in adapting themselves. The hysterical live under conditions they imagine and that are not existent as with an infantile mind, in this respect having an incomplete mental development, and they do not place true values on facts. We have been in the habit of considering reaction as pathologic or abnormal. The exciting circumstance is abnormal the reaction is normal. Also any reaction which 80 per cent of all people have cannot be considered pathological and cannot be given as an example of an abnormal condition. We must term this functional, that is within the limits of ordinary normal physiological action. The human being is ever ready to believe things that appeal to him and are easy of conception mentally. On test we find our adult brain still functioning in childhood manner, that our rationalizations are not sufficiently separated from our emotions or desire and that we are too prone to live our desires. At each uncomfortable situation we seek

to balance our conceptions to evade the uncomfortable situation at hand while an adult mind would be more ready to allow it to stand as is and be more immune to its unpleasantness. It is typical in these cases that the psychic disturbance caused is to be met with one at that moment less unpleasant. The patient's attention is therefore transferred to explainable pains, aches and suffering and the memory of these linger with more intensity than does the pain. Also the inhibition of activity, giving a greater feeling of insecurity, depresses the patient's power of action and leaves him in a distressed mental state. This acts as a vicious circle as it diminishes his power of recovery.

It is perfectly easy to see why a person who is constitutionally neurasthenic or hysterical will get into difficulty and stay there, but it is wrong to say that the same reaction does not occur in what we must call normal people. After all, clinically it is the heretofore normal people that give us these difficulties while the constitutional inferiors show their natural bend previously and do not seem to present special problems after trauma to the extent we would expect.

In attempting to explain phenomena doctors are very liable to accept any equation which tallies and is logically sound. Unfortunately we have only one method of proof and that is empirical or clinical. Evidently our conception of what should exist in a human being has been leading us into a false explanation. If we are in difficulty in these matters we find ourselves worse off when we attempt an explanation to a layman, be he the patient, a relative or legal aid. A solution or diagnosis is asked in terms which do not exist.

Immediately after trauma it is impossible to go into the patient's psychical condition because the traumatic condition dominates his attention. As the recovery is gradual his ability to exaggerate and amplify increases and we are in a quandary to estimate the remaining physical disability which originally was considerable and his hysterical element which was previously not discernible. The memory and the fear of what had gone by still holds his attention. An attempt to get along in the face of the previously induced sensitiveness and apprehension focuses his attention on a way out instead of on a way forward.

Without a frequent examination he feels himself neglected and with it his attention is centered. Examination by different men necessarily has a bad effect. If the second man fails to find what the first man did he loses sympathy and confidence but if he finds more the patient has foundation for doubt of the value of his previous treatment, which is still worse. Any small matter such as the exact location of a sensitive spot is enough. Whatever symptoms the patient has must be valued in terms of the three underlying conditions: a sprained back, a sensitive tissue and an intrinsic ability in a human being to modify his conception of his surroundings and being by what we call voluntary attention. Whether this last is organic or not is beside the question. Personally, I believe all thought is organic like a higher compounded reflex and our ability to translate it into a medium termed words induces us to consider it a different entity, which it is not. It seems, however, that we have the ability, within limits, to direct our attention as we see fit. Maybe even here it is not voluntary but simply an expression of an emotion. In this case our rationalization would be fatalistic or predetermined and simply a higher reflex. Such a conception would let us claim this entire symptom complex as of organic origin.

From a practical point of view we know that the major factors in a traumatic spondylitis cannot be dependent solely on the strain of lifting an object the like of which has been done for years. We must conceive our symptom complex as tridimensional, in which one dimension dominates but cannot exist alone. As we see these cases, many border on what we would

like to term a neurosis, this would imply that the organic back lesion did not exist. The diagnosis neurosis should not be made on negative findings, it is a real condition. Unfortunately only rarely can we commit ourselves to that effect; usually our opinion must be suspended until we can see what the case is doing and to what extent it can be modified or compensated by effort.

TREATMENT

The treatment of the immediate accident gives us little difficulty. We can always put on a plaster cast or a brace and then let him up. Some prefer keeping the patient flat in bed and then giving no brace, believing that there is a limit to the bed confinement but none to the partial disability; others feel that the sooner the gradual recovery is inaugurated the better for the patient. Physically either method is satisfactory; psychically either may be wrong. Personally I prefer getting him on his feet in a plaster cast because it relieves this doubts and fears, is safest and is a better way of controlling the patient.

After a plaster is no longer necessary the question of physical therapeutics is considered. The easy cases will get well regardless, the difficult cases thrive on attention and even get to enjoy their illness. If we do not do something for them they feel neglected and if we do something for them they do nothing for themselves. I see all too many cases in which physical therapeutics work in the wrong direction. It gives them a crutch to lean on so they do not stand on their feet. Whatever benefit may be derived from the temporary diminution of physical discomfort is negatived by the procrastination of effort on the patient's part. Handing patients over to a technician or a masseur makes matters worse. If it is necessary to resort to electric treatments on account of the patient's desire for attention we should use a modality that is not too comfortable and restful but one that is stimulating and painful. I suggest a metal electrode with a Oudin current. This raises beautiful welts on the patient's back and temporarily relieves him of his own pains. It is like the Pacquelin cautery by which we cured more ailments than we ever diagnosed.

The reasons for the prolonging of these attentions are not valid medically. Giving the mental encouragement needed by the patient to exert himself is a greater strain on the doctor, for which he gets no thanks. A premium is placed on the cultivation of a condition which we are later asked to remove as if it had no basis and did not exist, but which is then deep in the patient's being. After there is cultivated a neurotic condition we refer the patient to a neurologist who then attempts to make a purely neurological case and unwind the thread. This mental treatment can only be done by the physician having the patient in charge from the beginning, and in these cases it must be done by physical means. These cases go to the orthopedist and it is he who is responsible for the eventual outcome. We have no right to make neurotics of them and then ask for their cure, although that is the method now used, particularly on account of the legal and commercial aspects of these cases. We may not be able to relieve these cases of all their aches and pains but we should diminish instead of exaggerate their disabilities. From whom if not from us should these patients get help. If we insist on considering ourselves only bone carpenters we do wrong in holding these cases.

We cannot make the weak strong nor the sensitive insensible but we can do something to diminish their difficulties. I do not know how to make an accurate chronometer out of an Ingersoll watch nor would any one ask it of me, but I do know that I can use an Ingersoll for the same purpose and to a better degree of satisfaction than a perfect timepiece. The same philosophy must be hammered into the patient. They have no right to expect a perfect condition or a return to a previous one, people do not get younger

again. What they must seek is a method of getting along as well as before with what they now have. Therefore treatments in any form must be secondary to function. Nothing succeeds like success, use of the back is of more value in curing the back than any artificial applications or motions.

Gradual return to work by graded work and a gradual increased effort on the patient's part is the only possible and sane solution. Occupational therapy should be work in mild doses and not entertainment with useless occupation. For these cases outdoor occupation, such as work in a garden, is better than sewing. A prize fighter first tries someone his own size whom he can handle before taking on a champion, for a knock-out would shake his confidence in his ability and from this attitude he could not put forward his best efforts. We cannot expect a weak and sensitive patient to do a man's work on his first attempt at return. Too often we see them, after a two or three day try at their old job, quitting completely disheartened. Their next attempt at work will be complicated by fear of failure and their courage to succeed will be crippled. Part time work on part pay is indicated. Social conditions are against us in our attempt at rehabilitation. That is not our fault; they must be changed, we cannot change nature.

When in these cases the dominant lesion appears to be psychic and the remaining physical lesion questionable, the neurologists have accepted these cases as being neuroses. They label them functional, by which they imply the patient is responsible for his mental activities and that it is his will that is accountable for his condition. They throw out a camouflage screen of motive. Nobody exists in this world without motive, everything is explainable that way. Who wants to be weak? Labelling these conditions functional in no way answers the question. We are all candidates for the same physiological process. They were unwilling to consider the milder degree of hysteria and neurasthenia as pathological. The neurasthenic is essentially weak and tired and lacks ability to exert effort. The hysterical is living an incorrect mental assumption. He should be curable by a correction of his mental attitude or suggestive therapy. The neurologists show examples where simple suggestion effects cures. These are the long-standing cases where the organic lesion, if present, has entirely run its course. A sudden sharp suggestion is dramatic and appealing, its failure immunizes the patient to more attempts. The scientific doubt that exists in the mind of a learned man prevents his assuming the self-confident attitude of a charlatan and making the definite promises the patient desires. In this regard the quack has a great advantage and is bound to have some success. The socialization of medicine will add to the difficulty of handling these cases and improve the field for charlatans. Patients of this mentality and distrust do not lend themselves to a physician who insists that he should govern the patient's actions. The patient, like a child, wants to guide the doctor's hand and does not confide himself to his care. This subject has been treated by the neurologist as if it was purely a mental condition.

Our inability to completely comprehend these cases is no hindrance to our curing them on an empirical basis and I do not think it is a matter of supreme importance as to which element, the organic or the mental, should be emphasized. From a practical point of view these patients need help, we are the only ones who can give it to them and our reward will come, but unfortunately by being fed more unsatisfactory work if we show we can digest it. Then we will be doing something to elevate the status of the medical profession beyond that of a technician.

DISCUSSION

Dr. Robert E. Humphries: Dr. Oppenheimer's paper is an important contribution to the study of backache. It is my opinion

that these unsatisfactory cases have some real basis for the continuance of their pains. The patient usually gives a history of having felt something snap in his back either while lifting or when falling. *X*-ray pictures may be negative as to disease or traumatism, but it is well to remember that disease in its early stages, regardless of its nature, may not show in an *x*-ray.

We see many cases who have very definite signs of trouble with negative *x*-ray pictures. If the doctor tells such a patient that he has nothing wrong with him, the patient is likely to assume that the doctor does not know what he is talking about and will consult someone else. After this has continued through many consultations, one doctor telling him he has rheumatism, another that he has arthritis and still another that he has lumbago, etc., he becomes convinced that he has some rare disease of which the doctors know nothing. This condition of affairs is largely due to ourselves, in our efforts to convince the patient that we know more than his last consultant.

There are many factors in an injury that must be considered and I believe the most important is shock. We do not hesitate to do a double osteotomy on a patient, if necessary and yet if that same patient had both legs broken in an injury he had received he would be liable to die of shock, the effect of which is largely intestinal. A man came to the hospital complaining of an injury he had received in one of the nearby factories; in falling he had broken a rib, which had been treated by the doctor at the Industrial Commission. He still complained of pain but was considered a malingerer. On examination we found a distinct kyphosis at the 8th dorsal vertebra, markedly increased knee jerks and ankle clonis; he was scarcely able to walk. An *x*-ray showed a wedging of the 8th vertebra. He was admitted to the hospital, operated on, but did not regain control of his limbs. After his discharge from the hospital he was taken to court month after month for a hearing, his paralysis gradually growing worse all the time, when his case was finally settled he was unable to walk. Within two months of the settlement he regained complete control of his legs. I am quite sure that his condition would not have cleared up if a favorable settlement had not been made in his case, because this man was fearful of ever regaining his health again and therefrom becoming a public charge. When this fear was removed he promptly regained his health.

Dr. E. D. Oppenheimer: The subject is much too large to be covered briefly. There are too many angles to it; these cases come to us months after injury: the objective examination is negative: there is nothing organic on which we can put our fingers. If other opinions are asked, probably eight different men will give eight different opinions. Which is right? In these cases we have various elements that are developed to different degrees and we cannot explain one without considering the others. With time, the traumatic element diminishes and the mental increases. These patients should not see various physicians. It is bad for them: it adds to their doubts, they should be under better control than they are.

THE GAUZE PACK IN THE TREATMENT OF EMPYEMA OF THE PLEURAL CAVITY*

C. A. ROEDER, M.D.

OMAHA, NEBRASKA

IN THE surgical treatment of empyema of the pleural cavity, the so-called open method has regained favor during the past few years. The procedure designated as the closed method is ideal when it accomplishes perfect results, but it too often must be followed by open drainage. One of the principle reasons for the origin of the closed method was the thought that air in an infected pleural cavity was detrimental, mainly through preventing an expansion of the lung. The presence of air in an infected pleural cavity has never been proved to be harmful and the average application of the closed method of drainage rarely prevents the ingress of air. The presence of air is not, apparently, the cause of failure of the closed method; the lack of sufficient drainage must be given primary consideration.

The open method, with or without a rib resection, and the insertion of drainage tubes is usually satisfactory. If the visceral wall of the pleural cavity is not too thick and inelastic, the cavity is generally obliterated in from ten to thirty days. During this time there is profuse drainage of pus, and the opening into the cavity soon becomes just large enough to admit the drains, preventing an inspection of the visceral pleural wall.

The advantages of the draining tube procedure are that it is simple, easily cared for, and causes little distress. The disadvantages are that the drainage is most profuse and prolonged, and the lung "flaps" during respiration, for several days after the operation, producing a distressing increased cardiopulmonary rate. Not infrequently the exudate pockets away from the drainage tube, and the time for removing the tube is always in doubt, resulting often in a prolonged sinus.

A few years ago I began using the gauze pack in the surgical treatment of empyema of the pleural cavity with results so satisfactory that I feel that they should be reported. I have used it only in those cases requiring open drainage and where the lung was not permanently compressed by an organized thickened pleura and intra-pulmonary scar tissue. The advantages of the gauze pack are: (1) it holds the lung steady following the operation, which is most comforting to the patient; (2) it clears the exudate rapidly from the walls of the cavity; (3) it breaks up the numerous small abscesses in the periphery of the lung, which are usually present; (4) it eradicates external purulent drainage almost completely after forty-eight hours; and (5) it brings about an obliteration of the cavity at least as rapidly as any other method. The disadvantages of this method are that the gauze pack must be changed daily by someone experienced, and the first change is more or less distressful without light anesthesia. The wound in the thoracic wall may require dressings for several weeks after the drainage from the pleural cavity has ceased.

About 4 inches of a rib is always resected and the ends covered with surgical wax. As much of the exudate as possible is removed with a Poole sucker through a stab wound into the pleural cavity. The wound is then made about 4 inches long and, in order to facilitate packing, the parietal pleura is attached to the skin by interrupted sutures. The cavity is now open for inspection, and all of the exudate is removed, adhesions are divided and the walls are very gently wiped with gauze. Secondary pockets are widely communicated with the main cavity. With a long

* From the Department of Surgery, University of Nebraska. Submitted for publication November 7, 1929.

curved dressing forceps the entire cavity, starting at its extremity, is uniformily packed with bismuth iodized gauze, which

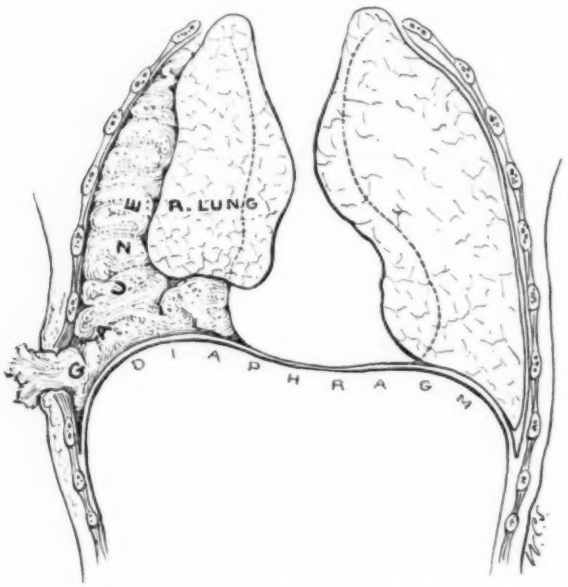

Fig. 1. Pleural cavity firmly packed with gauze. Note that every portion of infected pleura is in contact with the pack.

type of gauze has proved most satisfactory. This packing must be most painstakingly performed with the gauze fluffed. The first packing braces the lung by holding it in a fixed position, giving the patient a sense of comfort by preventing an increased cardiorespiratory rate. The succeeding packs are less firm and the cavity each day admits less gauze. Wrapping the blade of a broad retractor around the upper edge of the opening allows gauze to enter the cavity with no friction. In six or seven days, further use of the pack is rarely needed. The older the condition, however, the longer it takes to obliterate the cavity, and 10 days of packing may be necessary. Purulent drainage is generally absent after the third day, which is a marked contrast to those cases in which rubber tube drainage is used. In addition, the patients appear more comfortable owing mainly, I think, to the gauze acting as a splint and bracing the lung and mediastinum. The operations can generally be preformed under local anesthesia and the patients are, in most instances, out of bed and walking on the second or third day. Besides acting as a drain the gauze pack serves a valuable purpose in acting as a splint or brace to the lung as well as a counterirritant to the infected visceral pleura which assists greatly in the eradication of its purulent exudate.

CASE HISTORIES

Case I. University Hospital No. 28524. Boy, aged five, lobar pneumonia one month before admission. On May 25, 1929 right 9th rib resected and 500 c.c. thick cream-colored pneumococcic pus evacuated. Cavity packed with fluffed gauze which was continued daily. After second packing practically all purulent drainage had disappeared. The temperature was normal on the third day. Six days later cavity was practically closed excepting a small area in the region of the resected rib. Patient was out of bed the second day following the operation and appeared in excellent condition.

Case II. University Hospital No. 25318. Boy, aged fourteen, had "flu" three weeks previously. On April 28, 1928 right 10th rib resected and 650 c.c. of a thin dirty-brown-colored pneumococcic pus evacuated. Cavity packed with fluffed gauze and patient insisted upon walking back to his bed owing to the solid feeling in his chest. This patient was out of bed on the third day and with a normal temperature. Practically no purulent exudate was visible after the second day. At the end of the ninth day the cavity had disappeared and no more packing was necessary.

Case III. Wise Memorial Hospital No. 27744. Male, aged fifty, had "flu" one month previously. On January 23, 1929 right 8th rib resected and 1500 c.c. of thick cream-colored pus evacuated. Cavity packed with fluffed gauze which was continued daily. After the third day practically all purulent exudate had disappeared and the temperature dropped to normal on the fifth day. It required ten days of daily packing before the cavity appeared to require no more drainage. The patient was out of bed on the third day and felt quite well. This case is reported because it required the greatest number of gauze packs in my total series of 8 cases.

Case IV. Wise Memorial Hospital No.

20621. Male, aged fourteen, had "severe cold" three weeks previously. On February 16, 1925 right 8th rib resected and 400 c.c. of a thick dirty-brown-colored pus was evacuated. Cavity packed with fluffed iodoform gauze, and after the second daily packing no external drainage was visible. The temperature dropped to normal on the second day and remained so after the fourth day. In five days no more packing could be admitted and the patient was out of bed and feeling quite well.

Case v. Wise Memorial Hospital No. 21729. Male, aged nineteen, had pneumonia ending three weeks previously. On October 12, 1925 4 inches of seventh right rib resected and 400 c.c. of a thick yellow pneumococcic pus evacuated. The cavity was packed with iodoform gauze and on the third day no signs of external purulent drainings were visible. The temperature dropped to normal on the sixth day and no further packing was necessary after the eighth day.

APPENDICEAL ABSCESS (WALLED OFF)*

HARRY M. VOORHEES, M.D.

LOS ANGELES, CALIF.

THE subject I am discussing this evening does not consider those cases of appendicitis in which, from a surgeon's standpoint, the earlier appendectomy is performed, the lower our mortality; also we are not concerned, in this brief paper, with the diagnosis, which probably requires more acumen and judgment than the treatment of this condition, to which we are limiting our discussion.

It is my opinion that we see more of these undiagnosed or mistreated conditions than ten years ago, which is very easily explained by the existence of our numerous, so-called medical cults, faith healing, and the sure-cure electrical devices, or what not, now in vogue and given such wide publicity that the unsuspecting public are easily sold.

There are two recognized types of treatment, namely:

1. Surgery with its numerous technics, differing as to the individuality, experience and judgment of the operator.

2. The "starvation treatment," generally known as Ochner's method.

With the latter, I am aware that good results are obtained only in the hands of men who have had years of experience and whose surgical judgment far excels the average. Even in these expert hands, the errors in diagnosis alone usually exceed 2 per cent. As a wrong diagnosis usually results fatally, we have this percentage to add, in determining the true death rate by this method.

In the surgical handling of walled-off appendiceal abscess there are six essential points of technic which I bring to your attention, and if followed by the profession at large, will result, I believe, in lowered mortality and morbidity of our patients, namely:

1. Incision
   (a) Location and type
2. Exposure of abdominal viscera
3. Treatment of appendix
4. Drainage
   (a) At operation
   (b) Postoperative
5. A sutureless wound
6. Secondary appendectomy.

It seems a waste of time to tell surgeons to make their incision over the area, which is either flat on percussion or bulging and visible to the eye, or in which, if this condition does not exist, the abscess and often indurated abdominal wall can be easily palpated. It is a fact, however, that patients are operated on today, with easily localized pathology, in which no attention is given to the location of the incision. As the appendix is normally under McBurney's point, the attack is made in this region, and we see the non-infected portion of the abdomen opened, and the operator proceeds to perform an appendectomy, after breaking through an abscess wall. If this patient survives, the surgeon did not cure him.

1. By the type of incision, I mean a clean-cut, non-dissecting incision. Just the other day, I saw a man's lower abdomen opened in the midline for intra-abdominal pathology. While the approach was being made, the skin and underlying fat was dissected back on both sides, exposing a strip of facia 4 inches wide, and I thought at first a herniorrophy or some form of plastic surgery was in the making. There can be no excuse for exposing more than the minimum amount of abdominal tissue to infectious material from an underlying abscess. Our incision should be clean-cut and direct down to the pathology.

An ideal incision should, theoretically,

*Read before the Los Angeles Surgical Society, February 8, 1929.

be as wide as the abscess; and in thick abdominal walls is of necessity much wider. Rarely are our incisions too long. Have you ever seen your patient on the day following operation, after shrinkage has taken place, and been surprised at the small opening you made?

2. All of us feel a sense of security after operating a badly infected appendix, if in the removal we have seen and handled only the cecum. By making our approach in the proper location, the abdominal contents outside the abscess cavity are never seen. I realize that there exists the occasional case where the pathology is located intra-abdominally, and no contact with the parietal peritoneum, anteriorly or laterally, is made. In these centrally located conditions, often we can defer surgery until an approach can be found, with no interven ng intestine, provided no ileus exists to hasten operation.

3. The less we disturb ourselves regarding the appendix, the happier we wi.l be. There very seldom exists, in the condition we are discussing, an abscess where the appendix does not form a part of, and is well incorporated in nature's wall of omentum, cecum, and frequently intestine. Any attempt at removal will only increase our risk of breaking down this wall and, consequently, spread of infection. If the appendix is easily visible, and rarely this occurs, a simple ligature, before removal, with no attempt at inversion or pursestring of cecum, will suffice; and how well you know our fecal fistula's cure.

4. We make the peritoneal approach as wide as possible, consistent with the area in contact with the parietal peritoneum. After the abscess cavity is opened, a thorough aspiration, with removal of all detritus, enteroliths, and sloughing, loose tissue, is advised. The drainage must be so adapted that no back pressure exists to favor any accumulation of pus, distending the cavity, which we wish to collapse. For only by coaptation of the walls can we hope for granulation tissue to form, with subsequent obliteration. Now glass and hard rubber tubing, with their well-recognized complications, have long been discarded for soft, flexible rubber drains or tissue. The cause of secondary and recurrent abscess is often premature closure of peritoneum at the site of incision, before nature has ample time for obliteration. Therefore, soft tissue drains are used until the rush of serum, following relief of tension, has subsided. Frequent dressings, at six-hour intervals the first and second days and once daily beginning the third or fourth days, following operation; a forceps inserted down to and through the peritoneal level, with gentle divulsion of opening in the peritoneum, will keep the cavity open. If, in this procedure, pus wells up under pressure, either our drains have been removed too soon, or there is obstruction, which should be remedied by mechanical means. Frequent postoperative aspiration with syringe and tubing is not bad practice, and often removes obstructions that are due to sloughing tissue.

Our drains should pass easily into the cavity, with no constriction or pressure from surrounding muscle. If after the incision we find a tortuous tract leading down to our pathology to be drained, our approach has not been direct, and we may expect trouble. There is a general tendency to leave drains in too long. It is mechanically impossible to obtain obliteration of any cavity with a foreign body between granulating walls. If there is a wide opening, with free exit from a cavity, drains are unnecessary and often obstruct, and consequently an accumulation and back pressure are established, with reabsorption and elevation of temperature. We, therefore, remove all drains as early as possible, when wounds are wide open, often on second or third day, and follow their removal with frequent stretching of the peritoneal incision. Gravity and favorable bed posture are important to maintain. Moist dressings are of no benefit if dry gauze is changed frequently, and only favor maceration and skin infections;

vaseline gauze will protect against skin infections.

5. An incision without sutures produces, we find, the most gratifying postoperative abdominal wound. In draining abscesses, there is no benefit derived from passing sutures through an infected field, out into a non-contaminated muscle fascia or skin. All tissue through which they travel is immediately infected, and furthermore, when tied, they obliterate the space, which you want wide open for drainage. Sutures do nothing curative, but are an added menace, favoring extension of infection under the skin, fat, and fascia outside of our incision. If our fascia and muscle approach to an abscess is too wide, and we are afraid of postoperative evisceration, adhesive splints, not on the anterior abdominal wall, but applied from the posterior lumbar region, well back to the spine, fixed anteriorly with tape or safety pins, give far more support than any suppurative stitch applied in the fascia or muscle.

6. Provided the appendix is not removed by ligation at the cecum, a secondary operation for appendectomy is imperative. Schneck at Urban Hospital, Berlin, in his review of 382 cases of surgically treated appendiceal abscess, had an incidence of 15 per cent recurrent appendicitis, which speaks, unquestionably, in favor of secondary appendectomy. A period of two or three months should elapse after drainage ceases, the nature's removal of all latent potential infected tissue, favoring clean secondary operation.

Deuttman accepts the opinion held at the Giessen Clinic, regarding the two-stage operation, and has abandoned the one-stage radical procedure. In 367 cases treated solely by incision of the abscess, there were only 3 deaths, a mortality of 0.8 per cent of 314, or 86 per cent, of the patients who come to secondary operation, only one died, a mortality of 0.3 per cent. The total mortality was, therefore, 1.09 per cent which is very low compared with the one-stage, which averages 10 per cent or better.

For six months in 1925 and 1926, I was operating on approximately one-fifth of all emergency cases at the Los Angeles General Hospital, and personally operated on 11 cases with a postoperative diagnosis of walled-off appendiceal abscess, the histories of which I have obtained. The shortest time following an acute attack before operation was six days, and the longest, twenty-one. Hospitalization ranged from sixteen to thirty-seven days, with an average of approximately twenty-four and one-half days per patient. In 9 of these cases the appendix was left in, and was removed in 2 cases. In the 9 with the appendix left in, only one shows a record of secondary appendectomy; although all were told the appendix was not removed, and necessity for appendectomy was explained. There were no deaths, and wounds were essentially healed.

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CASE REPORTS

CASE REPORTS BY DR. CHAS. MURRAY GRATZ*

NEW YORK

FRACTURE OF THE FEMUR AND INTERNAL CONDYLE OF THE TIBIA

MISS C. F., aged twenty-two, was first seen in consultation with Dr. C. P. Hussey and Dr. F. J. Schwartz on February 7, 1927. The history was that she had been injured in an automobile accident on October 6, 1926, sustaining a fracture of the left femoral shaft at the junction of the middle and upper thirds, and also a fracture of the upper extremity of the left tibia, the line of this fracture extending obliquely from the lateral half of the upper articular surface downward and inward through the cortex of the inner surface just below the condyle. These fractures had been treated from the time of the accident until the time of examination by means of traction apparatus, Thomas splints, and ice tongs. The use of the latter had resulted in suppuration at the point of their application over both condyles of the left femur. There was absolute non-union of the fracture of the femoral shaft. Motion of the knee was limited to 10°, in a position just short of complete extension.

Open reduction was decided upon, and the patient was operated on at the Post-Graduate Hospital February 10, 1928. After anesthesia, she was placed upon the Albee table, with both legs fastened in extreme abduction. Incision was made on the lateral aspect of the thigh, extending 6 in. below and 3 in. above the point of fracture. Muscle tissue was found interposed between the bone ends, which probably accounted for the non-union. With the Albee saw using a twin-blade a 4 in. graft was taken from the lateral aspect of the lower fragment of the femur and a 2 in. graft from the upper fragment, care being taken to have the two fragments in perfect alignment. The graft from the upper portion of the femur was discarded, and the one from the lower fragment was slid across the point of fracture and held in position by kangaroo tendon after the Albee technic. The wound was then closed in the usual manner, both legs being sustained in wide abduction. The points of suppuration over the lower condyles of the left femur were carefully cleaned and iodine applied. Immobilization was obtained by means of a double spica, including the entire left leg and the right as far as the knee. The left knee was kept in extension and the cast was moulded to support the fracture through the upper portion of the tibia. The patient made an uneventful convalescence.

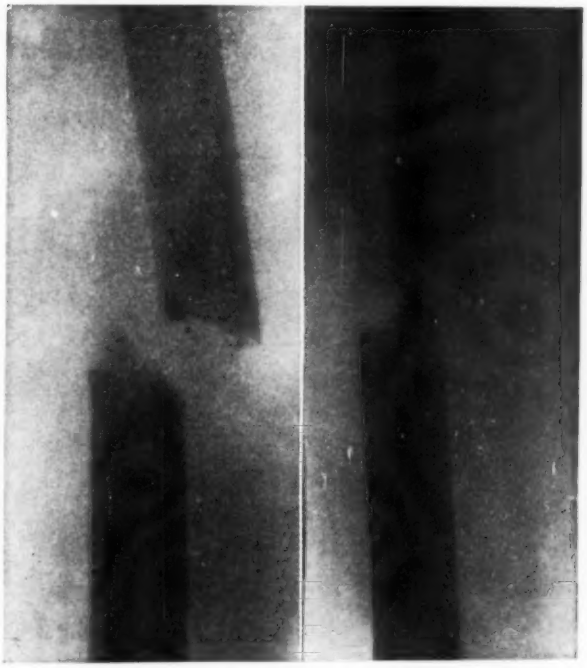

FIG. 1.

FIG. 2.

Radiographs taken through the cast on March 9, 1927, showed the bone graft in position and the fragments in perfect alignment. The cast was cut and the portion to the left leg removed on March 30, 1927, the entire cast being removed on April 4, 1927, and radiographs again made (Fig. 3). At this

* Read before the Section of Orthopedic Surgery, New York Academy of Medicine, 1929.

time the wound was found to be in perfect condition, the legs straight, only 10° of motion in the left knee, and the area of suppuration

able to swim and dance without difficulty, and she had discarded all supports, even a cane, since January 1, 1928.

Fig. 3.

Fig. 4.

over the condyles had improved. Massage was started, and the posterior portion of the cast was left in place until the patient left the hospital, April 23, 1927, with firm union of the fracture of the femur but limitation of motion in the left knee.

The next problem was to restore motion to the left knee. Massage and gentle manipulation was employed with slight improvement until July 25, 1927. At this time it was considered that the femur was sufficiently strong to permit manipulation of the left knee without danger. Accordingly an anesthetic was given and the knee manipulated until it was found that normal motion could be obtained. This was followed by massage, and the patient made an uneventful convalescence.

When seen on September 29, 1928, she was

POTTS' DISEASE TREATED BY MULTIPLEX GRAFT TECHNIC

THE patient, L. B., aged twenty-four, had suffered for many years from an extreme kyphosis of the mid-dorsal region due to tuberculosis, and finally developed a psoas abscess.

The technic used in this case is especially adapted for cases of marked deformity of the spine in which immobilization by tibial grafts of the spinous processes is desired. In many such cases it is not possible to secure a single graft of sufficient width to accommodate itself to the degree of kyphosis.

Four grafts were taken from the tibia, being cut sufficiently thin to permit their adaptation to the extreme kyphosis presented.

These were placed at right angles to the direction of the split spinous processes, the periosteum and medullary sides being alternated, and were firmly fastened in position by kangaroo tendon. The trapezius muscles were lapped over one another in order to prevent any tendency to straining of the grafts; the grafts were also placed one beneath the other from above downward, thus giving the maximum thickness over the point of greatest kyphosis and securing a leverage action, tending to give firm immobilization of the diseased area.

The history was typical of tuberculosis of the dorsal spine; the kyphosis had reached an angle of about 45°, and a psoas abscess had developed and discharged for about six months previous to the operation. An *x*-ray examination showed destruction of the 5th to the 12th dorsal bodies.

The operation was done on October 26, 1926. On November 21, 1926 a postoperative *x*-ray was taken, after which the patient was allowed to sit up. The psoas abscess discharged intermittently until November 19, 1927, but has not recurred since that date. No casts or braces were used at any time.

At the time of presentation the patient was free from any discomfort and was able to live a normal life.

DISCUSSION

Dr. Fred H. Albee: Dr. Gratz is to be congratulated on the results of the technic applied in this case. In such a case with dorsal region when the kyphosis is so markedly angular the spinous processes have separated widely and in as much as the diameter of the spinous process is small, the amount of bone available locally is most inadequate even though it might have inherent active osteogenetic potentiality. This, however, is not the case as we have every evidence the vertebral bone has a lower osteogenetic potentiality, as shown clinically by the frequent absence of repair following both disease and trauma in all portions of the vertebrae. Spies has pointed out that a fissure fraction of the articular process rarely unites and recommends operative fusion. Union of fractional lateral or spinous processes is the exception rather than the rule. The frequency of unsatisfactory repair or even complete failure of repair of a fractional or crusted vertebral body is well known, absorption or recession of bone frequently continuing long after the trauma. I tested experimentally this relative osteogenesis at Cornell Experimental Laboratories in 1910 and 1911, by taking blocks of bone of equal size from the spinous processes and ulnae of dogs, and incorporated them in various parts of the body of the dog, and I found a marked difference in the growing ability of the different types of bone, the vertebral bone being far below that of ulna bone. In such cases as this above all others, I believe we need additional bone, and bone of a higher osteogenetic potentiality than that of the vertebral bone.

As to the technic, in putting in grafts over a kyphosis as extensive as this, there are only two ways: one by the carpenter's method of bending a board about a rounded corner. He first makes numerous saw cuts most the way through the board on what is to be its concave side. Lateral tension then causes each saw cut to close at the concave surface of the board as it bends. The multiplication of saw cuts allows the bone to bend about a very pronounced kyphosis. In later years I have changed this method, by making the most of the bundle of reed principle and thus make the grafts very thin, cutting the bone from the tibia in thin strips and laying them somewhat as Dr. Gratz has indicated.

Dr. Leo Mayer: This is one of the most marked kyphoses we have ever seen at the Post-Graduate Hospital, amounting to almost 180°. Having tried in curves of a lesser grade to put in bone grafts, I realize how difficult it is to get a graft that will really hold. I would like to know from Dr. Albee and Dr. Gratz whether the alternative method of shaping grafts by multiple saw holes would fit a curve of this degree.

Dr. Albee: I would refer Dr. Mayer to a case in my last book[1] where the kyphosis was very nearly as great as this, with the graft in place, but it is a very much more difficult operation than this, and I would recommend this one.

Dr. George Anapol: I had a case of acute kyphosis, I believe a little more acute than the one presented, where I used three pieces of bone, making a bracket, so that the upper graft goes in the upper leg of the angle, the second in the lower leg, the two meeting at the point of kyphosis, and the third or thinner one coming between the two at about 45°,

[1] Albee, F. H. Orthopedic and Reconstruction Surgery, Phila., Saunders, 1919.

thus getting the bracket formation. The apex, of course is filled with bone, and thus we haye a similar mechanical condition to the one Dr. Gratz has worked out with the curved graft. This case is of twenty-years' duration. Since the graft operation the sinus has healed. That is another method of helping these acute angular conditions.

Dr. Gratz: I was particularly gratified by the end result for we got a very firm fusion, which showed that the pathology had completely cleared up.

As to the operative time, it was forty minutes. I am certain that if any fusion other than by bone graft had been done the patient would not have stood the operation.

TRANSPLANTATION OF THE URETER INTO THE BOWEL*

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ENCOURAGED by the work of Coffey, Peterson, Furniss and others, who have recommended the implantation

Fig. 1.

of the ureter into the large bowel for incurable vesicovaginal fistula, as well as in tuberculous ulcerations of the bladder with a good remaining kidney, we are reporting a case where several attempts at plastic repair were unsuccessful and where employment of this procedure brought relief after years of suffering and a cure of her condition.

T. H., colored, aged forty-seven, was admitted to the Urological Service of the Cumberland Street Hospital with a diagnosis of vesicovaginal fistula. Her chief complaint at the time of admission was an inability to control her urine. She had been married for fourteen years and had never had any children. There was a history of three miscarriages in the early months of pregnancy. The family history was essentially negative, there being no history of tuberculosis in any of her family. She had had whooping cough and measles during childhood and an attack of rheumatic fever at the age of fifteen. There was no history of pulmonary disease. Her trouble began ten years before admission with frequency and burning on urination.

She entered the Johns Hopkins Hospital at that time, where a diagnosis of right tuberculous kidney was made and nephrectomy advised. She refused operation and was discharged.

Five years ago her symptoms became aggravated, she entered Bellevue Hospital on May 29, 1924 and a right nephrectomy was performed. The pathological report confirmed the diagnosis of tuberculous kidney. However, she had very little relief and in addition, three years ago she began to wet herself. She became progressively worse and soon found it impossible to control her urine at all and with this complaint she entered our service on December 26, 1928.

Physical examination revealed a fairly well-nourished individual. Examination of the head and neck was negative; breath sounds were everywhere vesicular in character; no

* Submitted for publication August 15, 1929.

râles heard. The abdomen was soft, no masses were palpable; scar of right nephrectomy noted.

The bladder was filled with methylene blue and the fistula visualized. The fistula was found to be rather large with rigid walls.

On January 8, 1929, under spinal anesthesia, an attempt was made to repair the fistula through the vaginal route. Following this there was no leakage for about ten days. The area appeared well healed and we were about to discharge her when she again began to dribble urine.

On January 30, a second attempt was made to repair the fistula; this time by the suprapubic route. The fistula was visualized, resected and closed. The bladder on inspection showed signs of multiple ulcerations, apparently tuberculous in character. A suprapubic tube was inserted and the wound closed.

In spite of this, leakage through the vagina continued and the patient expressed a desire to have something done which would give her relief. A transplantation of the remaining ureter into the bowel was decided upon and performed on February 26, following the technic of Coffey. There was little postoperative discomfort. Fairly clear urine was seen to flow continually from the in-dwelling ureteral catheter. There was no abdominal distention.

On March 1, a left parotitis developed which was subsequently incised and drained. On the eighth day postoperative, the ureteral catheter came away. On the eighteenth day postoperative, there was a rise in temperature to 103°F. which lasted for one week and was associated with some tenderness over the left kidney.

From then on, her convalescence was uneventful. She has no difficulty in controlling her urine, voiding every three hours during the day and seldom during the night. Her chemistry one week before her discharge was:

Blood sugar	89.2
Urea	23.8
Uric acid	4
Creatin	1.6

Beside *x*-ray six days postoperative shows ureteral catheter in place draining through rectum.

ARTHRODESIS FOR FLAIL WRIST*

Sigmund Epstein, M.D.

NEW YORK

THE patient was fifteen years old in January, 1928. He had had infantile paralysis in 1916, and the right arm became paralyzed and useless. He came in with cubitus varus and a flail-like useless arm, with retained power in the biceps and trapezius only. The wrist was characterized by marked supination; his pronators had been put completely out of action by the infantile paralysis, inducing a markedly excessive hyper-supination deformity of the forearm. His hand went back another 45° by curvature of the radius, so that the palm was pointed backward, that is, the thumb pointing toward the center of the body. This produced marked insecurity.

On January 29, 1928, I did a preliminary stretching, putting the hand in pronation in plaster-of-Paris. On March 15, 1928, an arthrodesis was done. The patient now has a member which he can use for holding objects. Before operation, anything that was put on the palm of the hand fell off; now he can use the hand for grasping objects and bringing himself toward the flexed, grasping hand. He can now catch and pitch, which is a desirable function, and can lift objects with his hand, due to the stabilized wrist.

There is nothing extraordinary about the case, except that there have been very few operations of this sort demonstrated here since Dr. Arthur Steindler was here; but the patient now has a more useful hand than before, partly owing to the fact that the stretching has proved so useful in the preliminary treatment.

The method of arthrodesis was: A dorsal incision, disclosing practically no

* Read before the Section of Orthopedic Surgery, New York Academy of Medicine, May 17, 1929.

useful tendons, was made. The cartilage was simply peeled off the carpal bones wherever we found it by means of a knife; it was soft and easily separated, leaving a mass of pulpy cancellous short bones and bony cancellous medulla of the long bones of the radius and metacarpus. We then impacted these together in as good a position as we could get, which resulted fortunately in the extended position the boy now has. No graft was used.

DISCUSSION

Dr. Boorstein: Was anything done to shorten the tendons of the wrist? They must have been quite long on account of the flexed position.

Dr. R. E. Humphries: We have operated on several of these flail arms at the New Jersey Orthopaedic Hospital in Orange and have found that an arthrodesis such as Dr. Epstein describes gives very favorable results in controlling deformity of the hand and also in restoring usefulness. The results are not as uniformily good as an arthrodesis of the foot but a fair percentage of excellent results may be expected.

Dr. Armitage Whitman: Dr. Humphries spoke of the comparative results in the treatment the upper with the lower extremities. A friend of mine had complete paralysis of the upper extremity. He came to me one day and said: "I have found a miraculous Swede in Boston who has been working on me with massage." I asked him: "What can you do now that you could not do before?" and he moved his thumb over to approximate his little finger. And when I enquired as to the practical importance of an apparently insignificant movement he replied, "Well, I can now hold a bit of bread in my hand; I could not do that before. Now I can also hold a cigarette." These small improvements are very important and emphasize the great difference in the estimation of results between the upper and the lower extremity. In the lower extremity a muscle to be of functional importance must be practically normal. Whereas in the upper extremity the slightest movement may be of great value.

Dr. Epstein, *Closing:* At the first view of these tendons on the wrist one was struck with their excessive tenuity. There was no action to any of the tendons; they were flabby, thin, yellow, did not appear to be of much help in the way of transplantation work with any of them. I might have done some transplantation, but I have much more faith in bone operations than in questionable tendon operations. Dr. Whitman's remarks were very pertinent to this case. The boy regained a fair amount of power in the long flexor of the thumb. He can hold a fairly large object between the first finger and thumb; this has been developed since his operation. He had deformity at the metacarpal phalangeal joint of marked extension, and I was anxious to do an osteotomy across all the metacarpals for the purpose of increasing the flexion, but that is another thing that is improving since the operation; he has opened up a wide range of motion and can do much more with his fingers because the adhesions have been overcome and he has more power in the intrinsic muscles; but the muscles on the back of the wrist offered very little hope for any sort of operative work.

FRACTURE OF LATERAL CONDYLE OF FEMUR ASSOCIATED WITH TEARING OF ANTERIOR CRUCIAL LIGAMENT*

LEWIS CLARK WAGNER, M.D.

NEW YORK

OSTEOCHONDRAL fractures are by no means rare and after a thorough review of the literature one finds a great amount to be written on the subject. This type of fracture associated with ligamentous tear no doubt has been observed on many occasions but no definite report of cases made.

Classification. The etiology is always associated with definite trauma where there have been both external factors and muscular violence. The fracture of the articular surface of the femoral condyle (lateral) is the direct result of the factors, which tend to rupture the anterior crucial ligament. The direct factor in the cases described below was the individual being thrown or falling on the partially flexed knee. This was accompanied by violent rotation and forcible extension of the knee as the patient attempted to reestablish his equilibrium. Stretching of the anterior ligament is imminent after such trauma and if the force is great enough, tearing, or even rupture of the ligament, is certain; while if the cartilage or bone of the joint is of adolescent type there can be an associated osteochondral fracture. A. T. Fisher states this condition can be easily artificially produced in the fetus.

Pathology. When one explores the knee joint so affected there is always a moderate degree of synovial hypertrophy. The torn surface of the anterior crucial ligament and displaced bony fragment (which is usually wedge shaped and measures about 1 × 1.5 cm.) have acquired an attachment to the synovial membrane. There is a Y-shaped tear of the anterior crucial ligament, the uppermost part still attached to the fragment and the lower part in situ. The osteochondral fragment may be dislodged and find a new attachment on the anterior surface of the lateral femoral condyle. The original site of fracture may

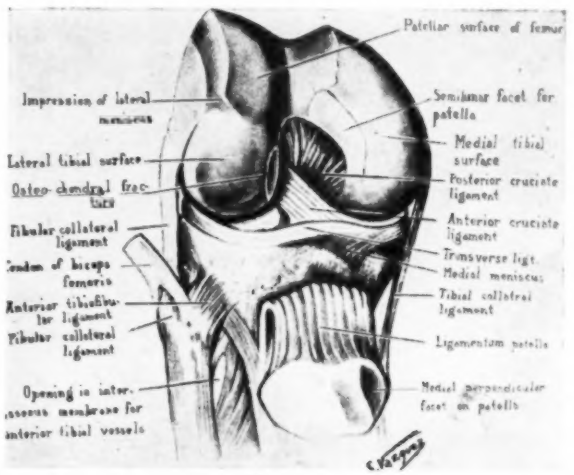

FIG. 1.

be covered completely with new cartilage but a small depression is still noticeable. One finds no necrosis in the dislodged osteochondral fragment but usually a proliferation of bony substance has taken place.

Clinical Classification. This type of fracture is very rare and occurs most frequently in the adolescent age. It has not so far been noted past twenty years of age. Its occurrence has been noticed but five times in the careful study of 4873 knee conditions, extending from the year 1880 to 1929 as taken from the private files of the late Dr. Virgil P. Gibney and myself.

The symptoms are marked by the absence of pain. Every knee injury in a young adolescent should be investigated with respect to a ligamentous tear associated with fracture. The line of fracture sometimes becomes distinct after walking has been started following an injury. The

* From the 3rd Surgical Division of the Hospital for the Ruptured and Crippled. Submitted for publication September 7, 1929.

patients walk with a slight limp and there is also a slight tendency to knock-knee, which is due to a partial rotation and subluxation of the knee joint. Extension is always limited and flexion is limited beyond a right angle. One finds no increased lateral mobility.

Fig. 2.

Fig. 3.

Diagnosis. The physical signs are quite similar to those of a loose body in the knee joint and a true diagnosis can only be made by roentgen ray.

Treatment. The ideal treatment as soon as the diagnosis is established is surgical. The knee joint is explored through a medial incision and a thorough inspection of the joint is made. The osteochondral fragment is easily removed with a small chisel. The attached part of the anterior crucial ligament is excised and removed with the osteochondral fragment, after which the knee is forced into complete extension.

Fig. 4.

Fig. 5.

REPORT OF CASES

Case I. (Dr. Wagner.) Miss M. W., aged fifteen years, was seen March 31, 1924 and

Fig. 6.

gave a history of being thrown from a bicycle and injuring the left knee four weeks previously. It had been treated with adhesive strapping but full extension did not return. Examination was negative except for the left knee. Flexion was normal but extension was limited at 170°. There was no tenderness. Roentgenograms revealed a slightly displaced forward fracture of the external condyle with no callus formation. Arthrotomy was performed on April 8, 1924 and the fragment removed. There was only fibrous union. A part of the anterior crucial ligament which was attached to the fragment was excised. Extension was readily executed without further manipulation. The convalescence was uneventful. Walking began on the tenth day and physiotherapy was given on twentieth day. Examination in March, 1925 showed no deformity and full range of motion.

Case II. (Dr. Wagner.) Miss A. D., aged nineteen, was seen September 10, 1925, because of deformity of left knee and incomplete extension. She gave a history of falling upon the flexed and adducted knee while dancing the tango. The accident happened in October, 1923. There was some difficulty in getting the knee straight. The family physician applied a splint, which was left on two weeks. Roentgenograms revealed a fracture of the external condyle with slight displacement. Massage was instituted and walking encouraged. Motion slowly returned but there was never complete extension and had become less in the past year. Examination of the knee revealed no fluid or tenderness. Extension was limited at 170° and flexion 90°. There was a slight knock-knee. Measurements: R. thigh 16 in. R. knee 13½, 13½, 12 L. thigh 15 in. L. knee 13¼, 13, 11½.

Fig. 7A.

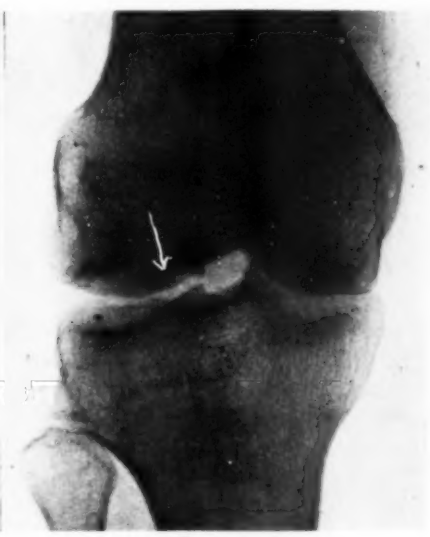

Fig. 7B.

Roentgenograms showed a displaced fracture of the external condyle between the joint surfaces. There is no absorption of the fragment and there seemed to be union to the anterior surface of the femoral cartilage. This fragment is evidently the opposing factor, which prevents extension. Arthrotomy was performed October 1925 and the fragment removed with attached part of anterior crucial ligament. The original site of fracture from which the fragment had been dislodged seemed to be covered with cartilage. The knee was forced into complete extension but not placed in plaster. Walking was begun on the tenth day and physiotherapy at the end of three weeks. Final examination December 1928 shows complete function. Measurements are the same and no pain.

Case III. (Dr. Gibney.) A boy, twelve years of age, was seen November 14, 1911, with a complaint of limitation of motion and pain in the right knee. Two years previous he had fallen while playing tennis and injured the knee. He was forced to stop playing because of extreme pain and immediate swelling. He was put to bed and treated by means of ice bags. At the end of two weeks he had a fair range of motion and was allowed to walk. The pain soon disappeared and function returned, except for complete extension. Examination was negative except for the right knee. There was a slight enlargement of the knee. Motions were good except extension was limited at 170° and flexion at 95°. There was moderate swelling in the popliteal bursa and under the ligamentum patella. Roentgenograms showed a small fracture of the external condyle and a fragment pushed forward and inward. There seemed to be union in the new position of the displaced fragment. Arthrotomy of the right knee was performed by Dr. Gibney in January 1912 and the fragment removed. Plaster was applied with knee in full extension, which was worn six weeks because of associated synovitis with the original injury. Examination two years later showed no difference in the knees.

Case IV. (Dr. Gibney.) A man, aged twenty-one, came under observation April, 1914 with a history that five years previous he had injured the right knee alighting from a buggy and was incapacitated for a month. Plaster-of-Paris was employed at the onset and on removal he was encouraged to walk. Motion returned but the knee could never be completely extended and at times after exertion it would become painful. Examination was negative except for the right knee. There was slight atrophy about the right knee and thigh. Extension was limited at 165°. Flexion was limited at a right angle. There was no particular tenderness about the cartilages and the patella was movable. Roentgenograms of the right knee showed an old mal-united fracture of the external condyle of the femur, which had become pushed forward and impinged upon the tibia in extension. Arthrotomy was performed on April 30, 1914 and the fragment removed. The knee was encased in plaster with the knee in full extension. Motion was started at the end of three weeks. At the end of six months there was complete function of the right knee and no pain.

Case V. (Dr. Gibney.) A young man, eighteen years old, was seen on March 7, 1892 with a complaint of incomplete extension of the left knee. He gave a history of missing his footing while turning a somersault, adducting the leg. He experienced extreme pain and was carried home. The knee became promptly swollen and was treated with ice bag and a posterior splint. Walking was encouraged at the end of a month. Examination nine months after injury showed extension of left knee limited at 150° and flexion at 85°. Measurements were not increased. A diagnosis of incomplete dislocation of the semilunar cartilage or loose body in the joint was made. On March 18, 1892 the knee was manipulated and forced into extreme extension. Plaster was removed at the end of six weeks. There are no further progress notes in the history. I assume in reviewing the records of this case that it was one of *fracture of the external condyle but was not recognized because roentgenograms had not been used prior to* 1897 *and arthrotomy was not performed in those days except for exceedingly urgent reasons.*

BLADDER DIVERTICULUM COMPLICATED BY CARCINOMA OF CLOACAL ORIGIN*

N. P. RATHBUN, M.D.

BROOKLYN, N. Y.

CARCINOMA occurring in a bladder diverticulum, while not a surgical rarity, is perhaps sufficiently out of the ordinary to warrant the recording of individual cases. The case which I am about to report presented a few factors in connection with the clinical history and pathological findings which merit attention.

The patient was a male, single, salesman, aged forty-eight, first seen on July 21, 1926. He had gonorrhea once in youth. This lasted several weeks; there were no complications and he thought he was cured. At the age of thirty-seven he was operated upon for duodenal ulcer. He made a good recovery and has had no digestive trouble since.

His present trouble began four years ago with a sudden severe pain referred over the sacrum extending through to the hypogastric region. A local physician who was called in found a distended bladder and catheterized him with prompt relief from his pain. Since that time he has been catheterizing himself two or three times daily and has not at any time voided any urine naturally. About one year before he had been examined by another urologist, told that he had a diverticulum and operation advised. Examination disclosed an individual rather underweight and somewhat cachectic in appearance. General physical examination was otherwise essentially negative. The prostate gland as palpated by rectum was slightly enlarged and a feeling of fullness was noticed above it. A soft rubber catheter passed easily into the bladder and 12 oz. of very foul cloudy urine were evacuated. He was advised to go in the hospital for further investigation and probable operation. We did not see him again until June 19, 1928, about two years later. In the meantime he had been keeping himself reasonably comfortable with regular catheterization until two weeks ago, when the urine became bloody. The findings were much the same as at the previous examination and this time 16 oz. of bloody foul urine were evacuated. Hospitalization was again advised and declined. He reported at irregular intervals for bladder lavage until September 18, 1928, when he finally went to the hospital.

FIG. 1. External appearance of diverticulum.

Cystoscopy on September 22 was rather unsatisfactory because of inability to secure a clean medium and because of very heavy folds in the bladder wall which could not be ironed out with the distending medium. However we noticed what we assumed to be the opening of a diverticulum in the port wall just above the trigone and mesial to the right ureteral orifice. The prostate encroached very slightly on the bladder neck.

A cystogram was made and the radiologist reported as follows: Cystogram shows an irregular bladder. Its under, posterior and upper surfaces on the right side are irregular and it has the appearance of being segmented. If this segmented aspect is due to a diverticulum it is a very large one. It might be due to growth practically dividing the bladder and the irregular appearance of the bladder would suggest tumor either intrinsic or extrinsic. The phenolsulphonephthalein output

*Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, April 24th, 1929.

showed 20 per cent the first hour, 15 per cent the second hour and 5 per cent the third hour.

The blood chemistry was as follows: urea 41.4, creatinin 3.57, sugar 138.8; CO_2 combining power 56.5. The concentration test showed a variation from 1008 to 1015.

Fig. 2. Diverticular cavity lined with smooth epithelial lining of epidermoid type. In lighter areas wall of diverticulum is infiltrated by carcinoma of epidermoid type.

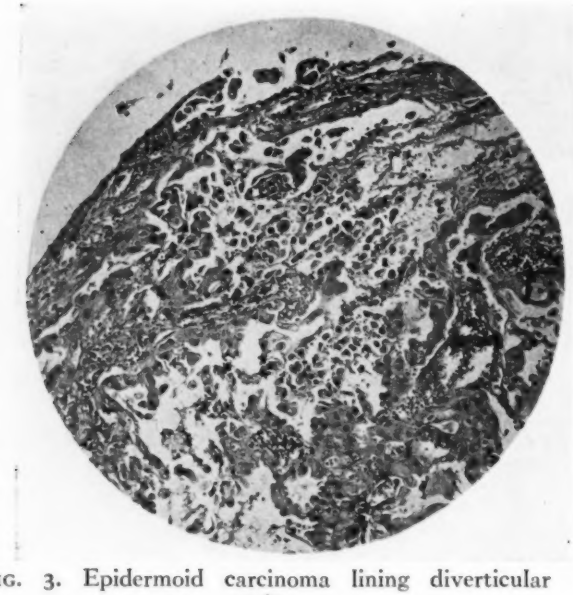

Fig. 3. Epidermoid carcinoma lining diverticular cavity.

Fig. 4. Large glandular structures with numerous goblet cells. Lumen of gland is filled with mucus.

Operation September 28, 1928: Median incision from symphysis to umbilicus. The bladder was exposed and freely mobilized. It was enormously enlarged and its wall was about ½ inch thick. There was a huge diverticulum almost entirely filling the true pelvis, with its opening on the posterior wall just above the trigone and mesial to the right ureter. Surrounding the orifice there was a papillary growth apparently arising from the cavity of the diverticulum and extending down on the trigone toward the internal

meatus. The bladder wall around the orifice appeared to be moderately infiltrated. At this time there was some doubt as to whether anything short of a total cystectomy would suffice, chiefly because of the proximity of the infiltrating area to the sphincter. We finally decided upon excision and resection, which was done, hugging very close to the ureter orifice and also the internal sphincter. There was some doubt in our mind at the time as to whether we had gotten sufficiently wide of the growth. The usual closure was made around a suprapubic tube and ample extravesical drainage. The operation was prolonged and extremely difficult because of dense adhesions to the diverticulum and the patient left the table in rather profound shock from which he rallied quickly with the usual treatment.

The pathological report was as follows:

Gross. The material consists of two large pieces of thickened bladder wall and a large diverticular pouch 8 cm. long and 6 cm. in diameter. This is shaped like a parabola. It is lined with a smooth gray membrane. The opening of the diverticulum in its fixed state is about 4 cm. in diameter. The margins of the opening are firm and white on section and along one margin of the opening some shaggy tumor-like material projects into the cavity of the diverticulum.

Histological. Sections show the diverticular cavity lined with malignant tumor of epidermoid type and this accounts for the gray color of the internal surface of the pouch. There was also in the wall of the diverticulum and close to the internal surface, clusters of adult intestinal glands. Deeper in the wall there are large loculi of mucus, surrounded in places by epithelium of intestinal type and in others by tumor epithelium of epidermoid type. The microscopic details mentioned would indicate that the diverticulum and new growth originated in some maldevelopment of the cloaca in its formation of the rectum and bladder.

Four weeks postoperative the patient was apparently progressing favorably, except that his suprapubic fistula continued to drain and he would not tolerate an indwelling catheter. He went on in this way for another month, up and about the ward, but voiding only a little urine. At this time he began to fail and rectal examination disclosed a huge mass in the pelvis, part of which I believe was inflammatory exudation and part a rapid extension of tumor tissue following an inadequate operation. He died on December 7, 1928. Autopsy was not permitted.

Fig. 5. Multiple collections of mucus surrounded by epidermoid carcinoma cells.

The points of interest are: (1) another case of carcinoma arising in a bladder diverticulum; (2) this patient led an absolute catheter life for six years, with no gross demonstrable obstructive lesion, unless it be the direct presence of the diverticulum itself, and at operation there was noted an enormous hypertrophy of the bladder musculature.

It would appear to me that two factors may have operated: (1) the mechanical obstruction of the diverticulum and (2) some more indirect disturbance of the normal mechanism of urination which interfered with the opening of the sphincter muscle. The third point of interest is the pathological report. This is one of several bladder tumors of apparent cloacal origin which have occurred in our clinic and they are being subjected to a somewhat intensive study and will be reported on later by Dr. Fisher and Dr. Denton of our staff.

DEPARTMENT OF RADIOLOGY

JAMES T. CASE, M.D., F.A.C.S., EDITOR

ROENTGENOGRAPHIC EXAMINATION OF THE FEMALE PELVIC ORGANS*

USE OF OPAQUE MEDIA FOR INTRAUTERINE INJECTIONS AND FORMATION OF PNEUMOPERITONEUM FOR GYNECOLOGIC AND OBSTETRIC DIAGNOSIS (FOURTH COMMUNICATION)

JULIUS JARCHO, M.D., F.A.C.S.

NEW YORK

ROENTGENOLOGIC examination of the female pelvic organs has passed the experimental stage and stood the test of time. Very few gynecologists can afford to be without this diagnostic aid.

INSUFFLATION IN DIAGNOSIS

In 1919, Arthur Stein and W. H. Stewart[1] described their method of pneumoperitoneum for roentgenologic examination of the peritoneal cavity. Theirs was the pioneer work in this method in the United States. For insufflation of the abdominal cavity they[2] used an ordinary lumbar puncture needle inserted one to three fingerbreadths below the umbilicus in the median line. The gas was insufflated slowly from a rubber bag connected with the tank. Either CO_2, oxygen, or a mixture of the two gases was used depending on the length of time required for the examination. The amount varied from 2 to 4 liters according to the condition of the anterior abdominal wall.

In their original article Stein and Stewart[1] noted that, in the exaggerated lateral Trendelenburg position, the normal uterus with its ligaments can be demonstrated by pneumoperitoneum; also, cystic ovaries and myomatous tumors of the uterus. In a 1920 article they[3] stated that the uterus and its appendages are shown in even better detail with the patient lying on the abdomen, head downward, on a table tilted at about 15 degrees.

In 1921, Rubin,[4] continuing his experimental findings of 1919, reported intrauterine insufflation of oxygen to determine the patency of the Fallopian tubes. His instrument included a manometer and flow volumeter for measurement of the quantity, flow and pressure of the gas.[5] If the tubes are permeable, there is a drop in pressure when the gas passes through the tubes into the peritoneal cavity. If they are not permeable, there is a steady rise in pressure and not more than 200 c.c. of gas should be introduced. This investigator[6,8] states that the patient should be fluoroscoped in the erect position after tubal insufflation, as this will show a single or a bilateral subphrenic pneumoperitoneum if one or both tubes are patent. In his later work he[6] has used CO_2 instead of oxygen and has added a kymograph[9] to his apparatus for the graphic recording of variations in pressure during insufflation.

Peterson[10] in 1921 reported his use of Rubin's method for transuterine insufflation of gas. For roentgenologic examination[11,12] the patient is placed in the moderate knee-chest position with the table inclined, as for the Trendelenburg

* Submitted for publication January 18, 1930.

position, at an angle of about 20°. If the tubes are permeable as shown by the drop in pressure after the initial rise, about

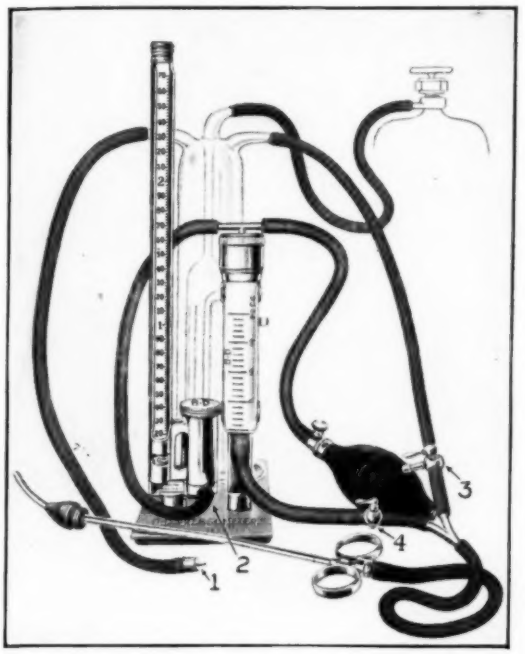

Fig. 1. Author's apparatus, the pressometer, for introducing air or opaque media into uterus, urinary bladder or kidneys, with a Machlett siphonmeter for perabdominal and peruterine introduction of oxygen or carbon dioxide.

800 to 1000 c.c. of gas are allowed to flow into the peritoneal cavity. If they are not permeable, transabdominal insufflation is used, which is indicated also in acute pelvic disease and if there is purulent and bloody discharge. For transabdominal insufflation puncture is made with a spinal puncture needle just below the navel. The Rubin apparatus is used for the abdominal as well as for the transuterine route. Peterson at first employed oxygen but soon changed to CO_2.

Sage[13,14] also has produced pneumoperitoneum by both the transuterine and transabdominal routes for roentgenologic diagnosis in gynecologic conditions. He prefers the transuterine route if the tubes are permeable and believes the method of value because it "gives us definite information about the patency of the genital tract from the cervix to the ovary."

INJECTION OF MEDIA OPAQUE TO ROENTGEN RAYS

More recently the method of utero-

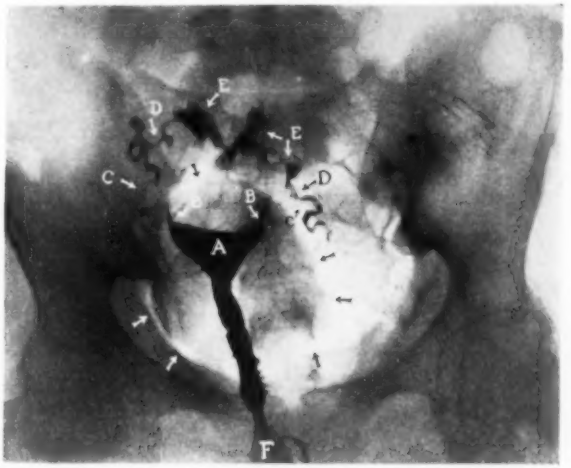

Fig. 2. Roentgenogram after peruterine injection of 900 c.c. of gas, followed by peruterine injection of 5 c.c. of iodized oil. The gas entered at a pressure of 180 mm. and dropped to 140 mm. Shadow of retroflexed fibroid uterus is outlined with six arrows. A. Triangular shadow of uterine cavity. B. Tubal sphincter. Note that sphincters are at beginning of interstitial portion of fallopian tubes and should therefore be called uterine, or still better cornual sphincters. C. Isthmus of tubes. D. Ampullae of tubes. E. Free oil in peritoneal cavity. In one place there is a droplet formation of oil in peritoneal cavity, indicating that there was fluid in tubes. F. Nozzle and volsella on cervix.

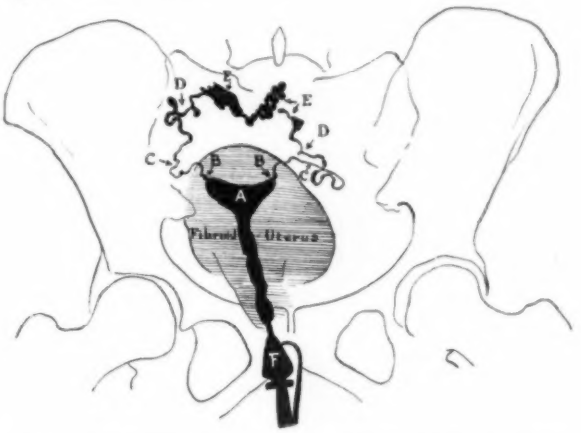

Fig. 3. Diagram drawn to illustrate various points in Figure 1.

salpingography by the introduction of various opaque media into the uterus and tubes has been developed, utilizing extensively the iodized oils: lipiodol, iodipin and lipiodine. These media have proved of great value in demonstrating normal

pelvic conditions, obstruction and disease of the tubes, tumors of the uterus and malformations; and in some cases they have served as therapeutic measures as well.

Fig. 4. Roentgenogram after peruterine insufflation of 1400 c.c. CO_2 followed by peruterine injection of 6 c.c. of iodized oil. Shows fibroids involving entire uterus. Neoplasm extends mostly to left, encroaching on cavity of uterus as shown by filling defect in triangular shadow on left side. It also occludes left fallopian tube at cornual end. On right there are fibromata of various densities. Fallopian tube on right side is normal and patent. Small amount of oil entering into peritoneal cavity. Sphincter at proximal end of interstitial portion of this tube is well shown.

Fig. 5. Same patient as in Figure 4. Uterine cavity is emptying itself of oil into peritoneal cavity, where it is widely distributed. Irregularity of tumor is shown well in this plate.

In October, 1926, Stein and Arens, who[15] had previously employed pneumoperitoneum only for gynecologic diagnosis[16,17] described their combined use of pneumoperitoneum and iodized oil injections. This was the first time that such a combination had been reported, although each method had been used separately for some time and proved of value. Carbon dioxide was insufflated by Rubin's method and then 2 c.c. of iodized oil injected. The patient was then placed in the Peterson knee-chest position and stereoroentgenograms were made. Stein and Arens[18–21] have since perfected their method and have designed a new instrument for the combined intrauterine insufflation and iodized oil instillation, which is self-retaining and facilitates the postural changes necessary for roentgenography. They have also designed a new table for the examination.

In cases where intrauterine insufflation is contraindicated or where the tubes are not patent, they employ transabdominal insufflation for pneumoperitoneum. Carbon dioxide is used as a rule, except in a selected group of cases in which oxygen is employed. From their results these investigators[21] conclude that "the maximum information as to the genital status, short of surgical exploration, may be obtained by the combined method of pneumoperitoneum and iodized oil instillation."

Some gynecologists have resorted to both tubal insufflation and iodized oil injections, but not the combined method of pneumoperitoneum and uterosalpingography. Forsdike[22] in 1925 reported the use both of insufflation of the tubes to determine patency and of iodized oil injections for radiologic study of the uterus and tubes. He did not, however, resort to tubal insufflation for producing pneumoperitoneum nor did he combine the two methods at one examination, but injected iodized oil one week after the insufflation test was made. He used air for insufflation and measured the pressure and the flow.

Haselhorst,[23] likewise, had recourse both to tubal insufflation and to iodized oil

injection, but did not use these methods in combination. He employed tubal insufflation in cases of uncomplicated steril-

Fig. 6. Roentgenogram of pelvic viscera after insufflation of 1000 c.c. of gas, followed by 4 c.c. of iodized oil. It shows a large ovarian cyst anterior to uterus. Faint outline of fundus of uterus is shown posteriorly to that of cyst. Normal triangular shadow of uterine cavity is shown distinctly. Tubes are well outlined. Free oil is entering peritoneal cavity. (For explanation of letters cf. Fig. 2.)

ity to determine tubal patency, and iodized oil injection when the results of tubal insufflation were negative or uncertain and in conditions other than sterility where roentgenologic study was necessary.

Rubin[8] made comparative studies of his method in tubal insufflation and iodized oil injection in 66 cases. The findings with the two methods agreed in 60 cases, but there was some discrepancy in the other 6.

SOMETHING NEW IN IMPROVED APPARATUS

Of late, I have combined production of pneumoperitoneum with the injection of iodized oil and find the results most gratifying. I place the patient on a J. Bentley Squier table. The latter had to be somewhat modified in order to make it possible to put the patient in the Peterson posture, which I find indispensable for good results in this work.

In the Peterson partial knee-chest posture, the gas fills out the pelvis and enters all recesses around the pelvic viscera.

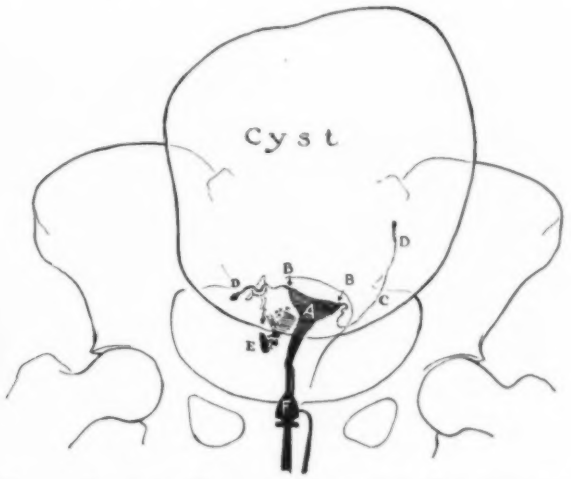

Fig. 7. Same as Figure 6 drawn to outline roentgenographic landmarks. (For explanation of letters cf. Fig. 2.)

The intestines gravitate out of the pelvis, facilitating greater clearness.

In my opinion, the apparatus I have designed (the pressometer) for the introduction of air or opaque media is especially well adapted for a combination of the two methods. To produce a pneumoperitoneum it is necessary to inject as much as 800 to 1500 c.c. of gas. It would be very undesirable to inject such large quantities of air into the abdominal cavity on account of its slow absorbability. I therefore attach a siphonmeter to the pressometer, through which the volume of gas can be measured, and introduce oxygen or carbon dioxide.

A "Y" connecting piece unites the oil reservoir, siphonmeter and nozzle leading to the uterus. The two short ends of the "Y" have stopcocks. When gas is introduced the stopcock leading to the siphonmeter is opened and gas enters the nozzle and uterus. When this is closed and the stopcock leading to the oil reservoir opened, the oil is allowed to run into the uterus. The oil is forced ahead by a rubber compressing bulb. The pressure of both gas and oil is recorded on the mercury manometer. The stopcock on the gas line has a side opening through which the gas

can be released, when the manometer registers too high pressure, as happens when the tubes are occluded.

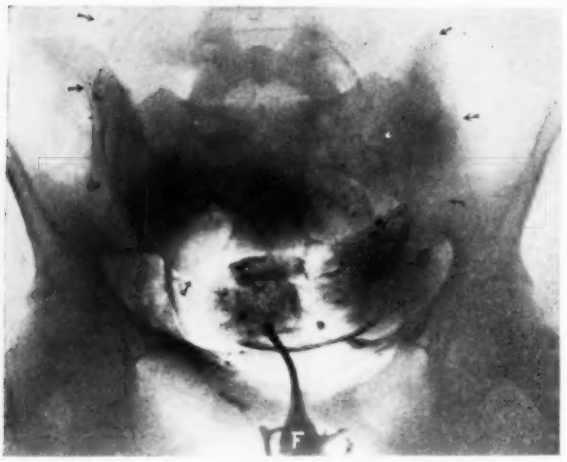

Fig. 8. Large right ovarian cyst outlined with arrows. Smaller cyst on left side was taken as a displaced uterus. Body of uterus was concealed by larger cyst. Roentgenogram showed exact pathologic condition. Oil was allowed to drain off uterine cavity before this plate was taken.

For preliminary transuterine pneumoperitoneum, connect adapter 1 to the manometer instead of adapter 2; turn arm of stopcock 4 at right angles to tubing to prevent the flow of oil from the reservoir into the nozzle.

Turn arm of stopcock 3 parallel to the tubing which leads to the siphonmeter. Then open the valve of the gas tank and gas will enter through the nozzle into the uterine cavity.

Stopcock indicated by "3" provides for the instant release of gas pressure by turning the arm parallel to the lateral outlet as illustrated.

To inject oil, detach adapter 1 from the manometer and attach adapter 2. Turn arm of stopcock 3 parallel to the lateral outlet as shown in Figure 1, and turn arm of stopcock 4 parallel to the tubing leading from the oil reservoir.

The instrument is then ready for the injection of iodized oil.

If the tubes are found to be occluded, a lumbar puncture needle is connected to the tubing leading from the siphonmeter, instead of the uterine nozzle, and the needle is plunged through the abdominal wall into the peritoneal cavity. The oil contrast medium is introduced through

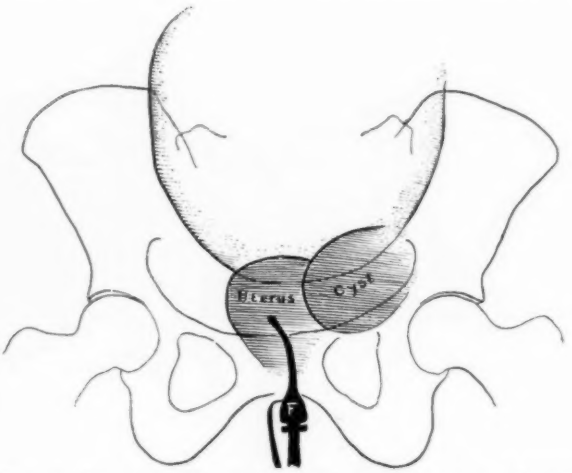

Fig. 9. Same as Figure 8. Drawn to illustrate relative size and relationship of cysts to uterus.

the nozzle into the cervical canal, as before.

THE AUTHOR'S METHOD

It would be superfluous to give the details of the transuterine introduction of the media as they have been enumerated in the numerous works of Rubin[4–9] and also my own articles on uterosalpingography.[24–26]

In transabdominal insufflation, all advise that, if there is a scar in the abdominal wall, the needle should not be introduced through this scar lest a coil of intestine be adherent to it. I have done a perabdominal injection of gas in a woman who had had eight operations, five of them abdominal, without difficulty or untoward effect. Most observers state that no local anesthesia is necessary. I fully agree with them, although in some neurotic patients it is best to inject procain at the point of the introduction of the needle.

For beginners, I should advise the use of oxygen for the creation of the pneumoperitoneum rather than CO_2. The latter may be absorbed too rapidly and the beginner may be so slow in handling the patient as to lose the valuable information that a larger quantity of gas would give

him. Later, however, when one is sure of one's technique and can speed up the work, CO_2 has greater advantage because its more rapid elimination contributes to the comfort of the patient.

I use the abdominal route for the introduction of gas when an attempt at its introduction through the uterus has proved an example. In this instance the combined method helped to exclude malignancy and saved the patient a ninth operation.

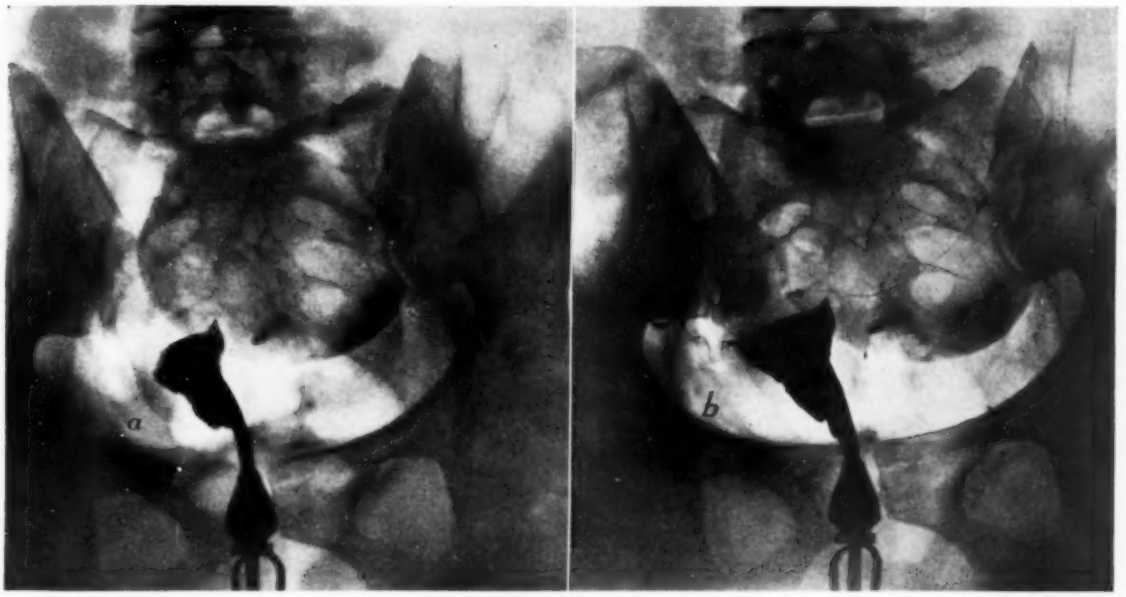

Fig. 10. Left ovarian cyst and right cystic ovary. Roentgenogram of pelvic viscera after insufflation of 1100 c.c. of gas. a. After injection of 4 c.c. of iodized oil, tubes are not filled. b. After injection of 6 c.c. of oil, tubes well outlined. This emphasizes the fact that sufficient contrast media must be injected; also, necessity of taking series of plates.

After 3 c.c. of the opaque oil medium are injected into the uterus, the first roentgenogram is made. More of the oil is then injected, and additional plates taken after 5, 8, 10 or even 15 c.c. The

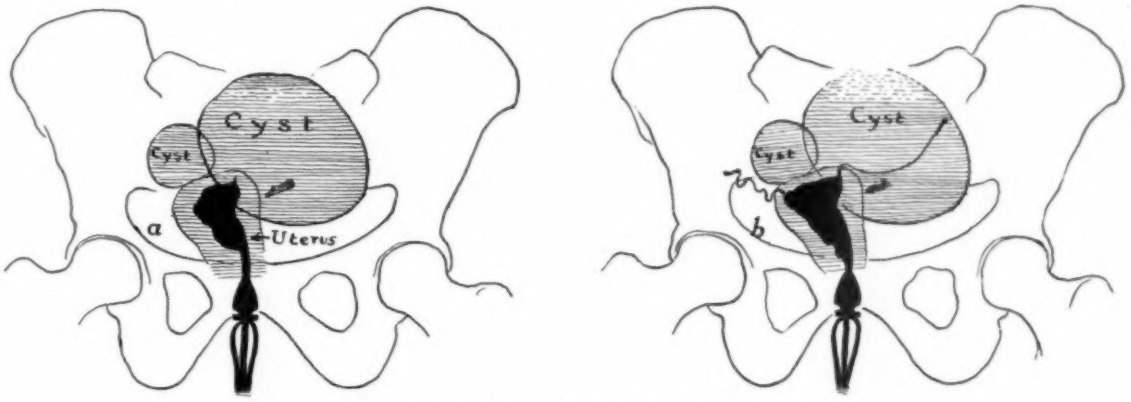

Fig. 11. Diagram to illustrate important points in Figure 10.

the occlusion of the tubes, when there is a bloody or purulent discharge, or where there is a suspicion of carcinoma of the corpus uteri. The case cited above of the woman who had had eight operations is amount of oil to be injected and the number of films to be made depend entirely upon the experience of the physician in making a diagnosis and his desire for more complete records. At the beginning, he is

likely to expose more films than after he has acquired greater skill and experience in their interpretation. It is advisable to make one set of stereoscopic roentgenograms.

The combination of these two methods is indicated only when additional information, not obtainable by either method alone, is desired. When successful it enables the clinician to map out normal and abnormal states of the pelvic viscera. It outlines the inside and outside of the uterus. It often shows the tubes and normal ovaries. Neoplasms of the uterus and adnexa are often plainly visible. It also brings out distinctly the sphincters at the proximal end of the interstitial portion of the Fallopian tubes. This would lead one to call these sphincters uterine; or still better, in order to denote their exact location, cornual sphincters. That the sphincter is part of the uterine structure and is lined by uterine mucous membrane was shown by Römckes' anatomic investigations, as reported by S. N. Bakke[27] of Norway.

This method makes the diagnosis more precise. It often enables the surgeon to decide beforehand the best type of operation. It gives him a chance to explain to the patient what is likely to be done for her when operated upon. It enables the patient very often to choose the method of treatment, whether it is to be *x*-ray or surgery. This has happened in my experience on many occasions in treating women with fibroid tumors and sterility. These patients, when informed that the operation would not help them to become mothers as the uterus would have to be sacrificed, chose irradiation instead of operation for the relief of their condition.

I prefer to keep the patients in the hospital for twenty-four to forty-eight hours, especially those who receive more than 1000 c.c. of gas, as they are likely to have a great deal of shoulder pain and abdominal discomfort.

The roentgenograms, in most instances, are highly instructive, bringing out facts entirely unsuspected. On several occasions I have found the patient to have bilateral ovarian cysts, while the pelvic examinations made by experienced men suggested only one cyst. This occurrence is shown in some of the accompanying roentgenograms. Such a disclosure was of great moment to me when I had told a patient that she had one cyst and assured her that she would retain her menstrual function and power of reproduction. I had to modify my statement after her roentgenogram disclosed neoplasms of both ovaries.

May I again remind the worker that the strictest asepsis should be maintained? Gentleness of technic will gain the coöperation and confidence of the patient, will facilitate the work and lead to good results and few complications. The physician does not require special skill or great training, only undivided attention to minute detail.

I have, in some cases, attempted to fill the bladder with gas after introducing iodized oil into the uterus but unfortunately did not obtain as gratifying information as did F. C. Steinharter and S. Brown.[28] Possibly, I did not give it sufficient trial.

I wish to express my gratitude and appreciation to Dr. A. S. Unger, director of the Department of Radiology in Sydenham Hospital, for his kind help and cooperation in doing this work. Also to Miss Florida Wyble, head technician of Sydenham Hospital, for her untiring assistance.

For the sake of brevity the histories of the patients are not given, as this article deals largely with the roentgenologic findings. Interpretation of the findings in most of these cases was corroborated by the subsequent operations.

CONCLUSIONS

1. The combined method of inducing pneumoperitoneum by insufflation and of uterosalpingography yields valuable diagnostic information in gynecology.

2. The author has introduced a new apparatus (the pressometer), which is

well adapted to the combination of these two methods.

3. In the hands of beginners, oxygen is best used for insufflation, because it is more slowly absorbed and allows ample time for roentgenography. In skilled hands, however, the use of carbon dioxide contributes to the comfort of the patient.

4. Use of the combined methods enables the clinician to map out normal and abnormal states of the pelvic viscera, outlines the inside and outside of the uterus, brings out the sphincters sharply, shows the fallopian tubes and ovaries, and often makes neoplasms of the uterus and adnexa plainly visible.

5. The procedure should be performed in the hospital under conditions of strict surgical asepsis.

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THE ROENTGENOLOGICAL ASPECTS OF EMPYEMA*

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ROENTGENOLOGIC study is of value in empyema in two ways. The roentgenologist's cooperation is required in dealing with suspected cases, for the diagnosis of the presence, amount and position of fluid in the pleural cavity. His assistance, however, is also required in established cases, to observe the progress of the disease, to determine the effects of surgical procedures, and to elucidate factors preventing resolution. Fluid in the pleural cavity, except in minutest amount, can always be demonstrated by complete roentgenologic examination. The appearances produced are, for the most part, characteristic, especially when effusion is the only lesion. Some difficulty may occur in cases with double lesions, either primary lung disease with secondary empyema, or more rarely, primary empyema with secondary lung or pericardial involvement. *X*-ray study also permits accurate localization, whether the fluid lies superficially or deeply. This cannot be achieved with any degree of certainty by physical examination; in cases of deeply placed fluid it is impossible. Pleural effusions may exist either as free fluid, or may be loculated by adhesions, and may therefore be discussed under these two main headings.

The effusions associated with cardiac or renal disease, with rheumatic fever, with early malignant disease of the lungs and the uncomplicated effusions occurring in tuberculosis are all simple, non-purulent effusions or transudates, and do not properly come under the heading of empyemata. They produce, however, roentgenologic appearances almost identical with those produced by the free purulent effusions. These include a proportion of the acute pneumococcal exudates, and practically all the acute streptococcal, staphylococcal and influenzal exudates in the earlier stages. From the point of view of treatment, it is of great importance to distinguish these free effusions, especially the streptococcal type, as it is necessary to wait for localization before instituting any form of radical drainage. Free purulent effusions also occur when the simple effusions of tuberculosis, or of malignant disease, become infected; or when the pleura becomes involved secondarily to chronic pyogenic disease of the lungs, such as abscess or bronchiectasis.

Pyogenic effusions have a natural tendency to limitation by adhesions. Such adhesions may exist from the beginning, especially in association with pneumonia, or may occur subsequently, as the disease develops. This causes the formation of localized collections of pus, so-called encapsulated, loculated or pocketed empyemata. These may occur in any portion of the pleural cavity as peripheral, mediastinal, diaphragmatic or interlobar pockets. Pleural effusions other than pyogenic, do not show this tendency to localization.

It is unnecessary to dwell at length on the purely mechanical details of the roentgenologic technique in the examination of these cases. A brief consideration of the general scheme of the examination of an empyema case is, however, advisable. The first roentgenologic examination in most clinics is usually the routine examination of the chest, taking a postero-anterior stereoscopic pair of films, with the patient sitting or standing. Tube distance should be at least four feet. With a patient who is very ill a "bed chest" roentgenogram, with the film under the patient's back and a short tube distance, will have to suffice although it is not of the same value. Such routine films will show the presence of fluid in any part of the chest, except retrocardiac, or low down

*Read before the staff meeting of The Lockwood Clinic, Toronto, February, 5, 1930.

in the posteroinferior sulcus, and will give an indication as to the line of approach for any further studies.

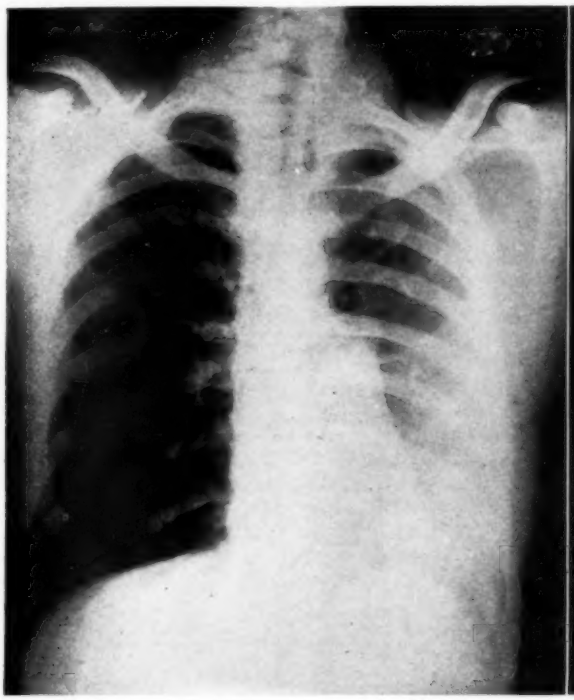

Fig. 1. Axillary loculated empyema as shown in posteroanterior view, illustrating difficulty of diagnosis from one film only.

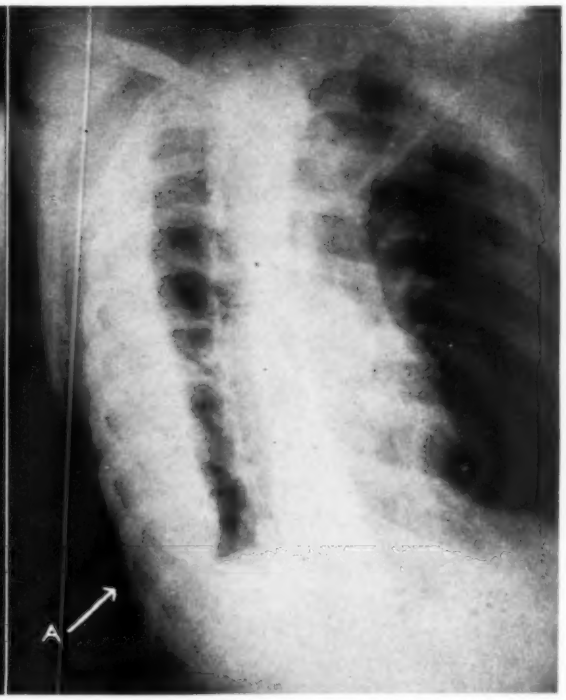

Fig. 2. As Fig. 1 but roentgenographed in the left anterior oblique position, showing fluid collection to lie posterolaterally.

Following this a fluoroscopic examination is essential. The patient has to be rotated and examined in all possible positions, sagittal, oblique, lateral, upright, prone, and supine. There are several principles involved,—one is to try to bring the surface of any suspected body of fluid into the line of the rays, as the diagnosis of fluid may depend on the determination of a definite edge. This is illustrated particularly well in Figures 1, and 2, which show an axillary loculated pocket as seen posteroanteriorly, and as seen in an oblique position. In the anterior film the ray is taken through the fluid, and the appearance is in no way characteristic; by rotation, however, the clear line of demarcation between the lesion and the lung is well brought out. The second principle is to determine the point at which the shadow suspected to be fluid, comes most prominently in contact with the apparent edge of the chest; that is, to establish definitely a relationship to the parietal pleura. The point on the chest wall to which the rays are then tangent, is the point at which puncture can best be done (Point A in Fig. 2, for instance). Another point is to determine whether any marked change of contour occurs with the patient supine, or prone. If at all possible, the position of the fluid density, as seen in the lateral position, should also be determined, irrespective of which oblique position gives the most prominent views.

The same principles hold for the location of pockets in the interlobar fissures. The main fissure between the upper and lower lobes should be considered as a relatively flat surface, running obliquely downward and forward from the level of the second interspace behind, to the sixth rib in front. In the front view we therefore look obliquely through it. To observe the clear-cut edge of a fluid pocket in this fissure, one has the choice of two good positions. In the direct lateral view one is looking

along the fissure from side to side. Or again, by leaning the patient markedly backward and, if possible, tilting the tube so that the incidence of the rays is from above and behind the neck down towards the xiphisternum, the fissure is visualized from end to end. In both of these ways a fluid edge can be beautifully demonstrated (Figs. 3, 4 and 5, show a pocket so visualized.) The upper surface of the middle lobe lies horizontally and is therefore quite suitably visualized in the posteroanterior position. Study in the lateral position moreover, shows any shadow from fluid in this fissure to lie anteriorly.

Fig. 3. Interlobar empyema between middle and lower lobes as seen in the posteroanterior view. Aspiration was done under fluoroscopic control and over 20 c.c. of pus was obtained.

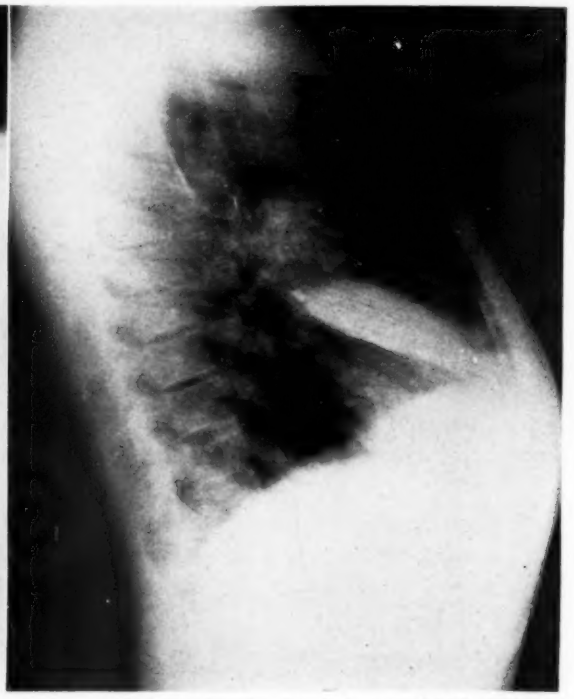

Fig. 4. As Fig. 3 showing lateral view. Old lipiodol from previous per-tracheal lipiodolization is still present.

Having determined by such fluoroscopic examination the best positions in which to demonstrate the lesion, the patient is again radiographed. One or two additional films are taken in the positions found most diagnostic; this usually includes one oblique position, and one with the patient prone, or supine. In addition, a direct lateral roentgenogram, with the side of the lesion against the film, is of great value. If the shadow caused by the fluid can be visualized even vaguely in a lateral film, one can get quite accurate localization. In this way, by the combination of fluoroscopy and radiography, the expense of using multiple films in many positions is avoided.

The roentgenologic appearances produced by free effusions in the pleural cavity are well-known, and are characteristic. There is a gradual obliteration of the clear lung field by a homogeneous dense shadow, commencing with obliteration of the costophrenic angle (Fig. 6) and extending upwards. As seen in the posteroanterior view, the upper margin of the shadow curves from within, upwards and outwards, with a concavity upwards. In the absence of associated lung lesion, this upper edge may be relatively sharp, but as the fluid accumulates, the line of demarcation between fluid and lung becomes somewhat more hazy, owing to the zone of compressed atelectatic lung immediately overlying it (Fig. 7). Actually, the upper surface of the fluid presents a concavity upwards,

not only from within outwards, but also from front to back, the level being highest behind. There is then formed a bowl-shaped surface in which lies the compressed, partially atelectatic lower lobe.[2] This conformation is produced by the combined action of the forces of gravity, of the elastic recoil of the lung tissue, of capillary attraction, and of the limiting effect of the fixed hilus.[3] This curve is the characteristic sign of fluid, and is particularly true for the transudates, or the thin purulent fluids. A true primary purulent effusion, however, ordinarily commences as a thin surface layer of fibrinous, non-fluid exudate, which at first shows as a general "veiling" of the lung field and as a narrow double line along the axillary border of the lung field. This has been called lamellar pleurisy, and is especially common in children.[3] Later, this may remain a narrow continuation of the shadow of the fluid upwards into the axillary line[1] (Fig. 8). The shadow produced by fluid has three definite characters. The density is quite homogeneous; it completely obliterates the line of the diaphragm; and in an ordinary chest roentgenogram it almost conceals the rib shadows except at the lateral edge. As the fluid increases in amount, it gradually fills the pleural cavity till the whole lung field is blotted out. When any considerable quantity of fluid is present, especially on the left side,[3] the heart and mediastinum are pushed over to the opposite side, the ribs elevated and the interspaces widened (Fig. 9). Where the mediastinum has been fibrosed by previous inflammation, this displacement may not occur.

Fig. 5. As Fig. 3 showing the effect of roentgenographing from above and behind, along the plane of the main fissure.

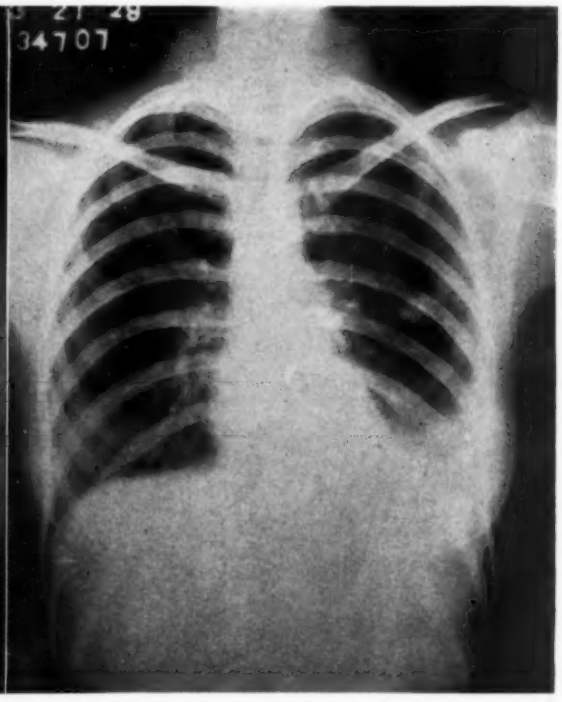

Fig. 6. Small pleural effusion (tuberculous etiology) occupying the costophrenic angle.

The effect on the distribution of fluid, of change of posture from standing to lying down, is important. With free fluid such as is found in transudates in the absence of a pneumothorax, the fluid moves slowly and almost imperceptibly into the apex, causing a general darkening of the whole lung field relatively to the other side.[1] With true pyogenic exudates, however, the surface of both the parietal and visceral pleura are coated with thin layers

of fibrinous exudate, which tend to fusion at the edges; for this reason very little alteration in fluid level takes place on lying down. There is some general increase in level, associated with the altered intrathoracic pressure from the abdominal viscera, but there is essentially no redistribution of the fluid even in the absence of true pocketing. (Stewart, of New York, quotes a case of a patient who was completely inverted without alteration of the fluid contours.)[1]

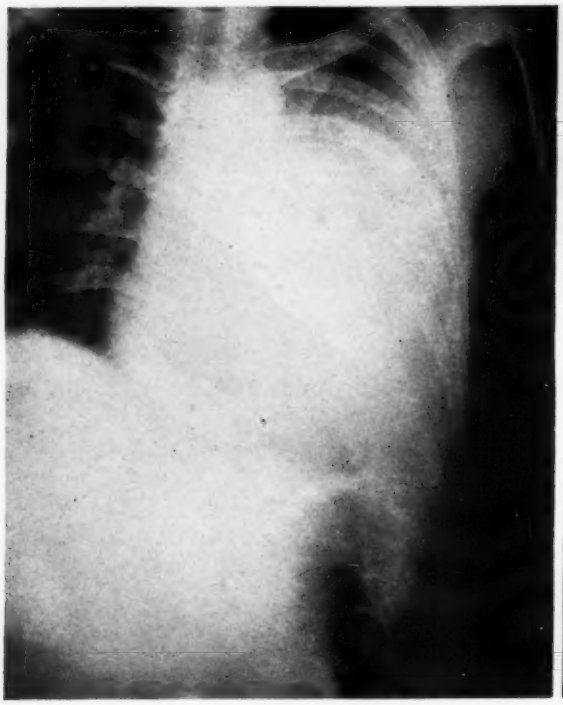

Fig. 7. Extensive free empyema of left pleural cavity following influenza. Over 250 c.c. of pus was aspirated and resolution obtained by closed drainage.

Fig. 8. Extensive free effusion (etiology unknown, but a streptococcal culture was obtained from fluid) with upward extension toward the apex.

The shadow produced by fluid has to be differentiated from the shadow of the various consolidations of the lung or pleura. Of these, pneumonia occurs most frequently. The consolidation of pneumonia is, however, rather less marked; the line of the diaphragm can usually be made out; there is no characteristic curve; and it can often be shown, by fluoroscopic study, that the lesion lies within the lung tissue. The density in malignancy tends to be more circumscribed, and to lack a defined edge. The density produced by atelectasis is always distinguishable by the deviation of the heart and mediastinum towards the side of the lesion, and by the relative rib collapse on that side. Thickened pleura, resulting from an old lesion, often suggests fluid, but seldom persists over the whole pleural field and, if of long standing, causes contraction deformity of the thoracic cage of that side. A real difficulty, however, is met with when pneumonia or malignancy co-exist with fluid, and it may be impossible to differentiate the shadows produced by the fluid and by the consolidation respectively.

Loculated effusions may form in relationship to any portion of the surface of the pleura, superficial or deep. Various standard treatises [1,2,3] on the subject classify and separately describe these pockets in relation to their different situations. They have, however, certain characteristics in common. The shadows produced by such collections are dense, homogeneous shadows with at least one definitely circumscribed edge which follows normal

anatomical pleural boundaries. As tension develops within these closed pockets, they have a tendency, moreover, where they impinge on yielding lung tissue, towards the formation of a smooth, circular boundary. Where formed in relation to the parietal pleura, some have their base upon the parietes, and bulge deeply into the elastic lung (Fig. 10). Multiple pockets may form, either as separate pockets or intercommunicating (Fig. 11). Some, however, produce an appearance very much resembling that of free fluid, and are produced by the walling off of a free effusion by adhesions; they are, as it were, a fixation of that process. Pleuromediastinal effusions show as localized widenings of the mediastinum sometimes parallel to the mediastinum, sometimes as a shadow with a border concave upwards and outwards, occupying the costophrenic angle.[2] Where formed in relation to a pneumonic process, as they often are, their shadows may be continuous with that of the consolidation. Even so, however, they have always at least one defined border which is related to pleura.

In their book on the roentgenology of the chest, Wessler and Jaches[1] give an excellent detailed classification of such loculated effusions. This may be summarized as follows,—

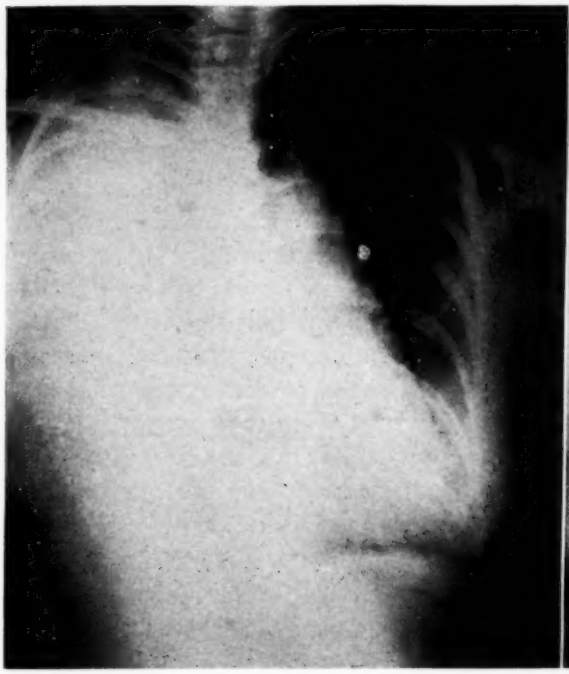

Fig. 9. Large pleural effusion filling the whole pleural cavity, associated with malignancy of the lung; 60 ounces of fluid were aspirated.

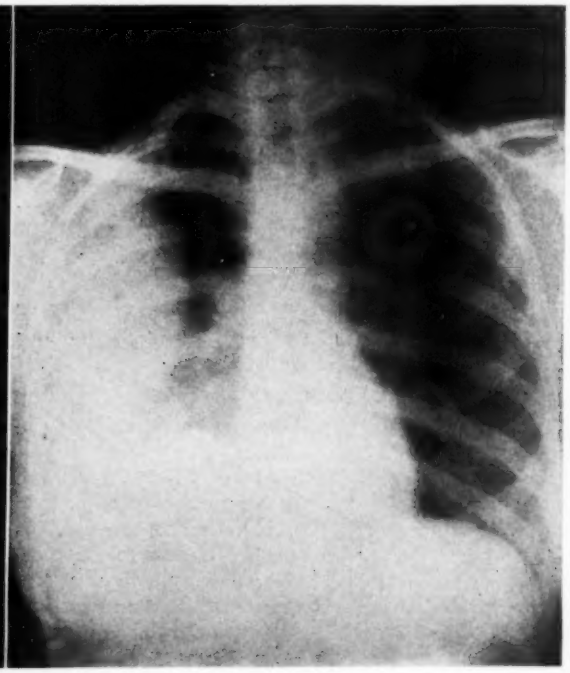

Fig. 10. Loculated empyema following pneumonia. Patient developed a bronchial fistula, but complete cure occurred following drainage through the chest wall.

A. Superficial Effusions or Parietal Encapsulated Effusions

1. *Axillary*..... Either anterior or posterior.
2. *Basal*..... Tends to resemble a free effusion and to lack the more usual contour of pocketed effusions.
3. *Apical*..... Very apt to be mistaken for apical consolidations.
   Has a strong tendency to extend, and become generalized.
4. *Mesial*..... Lie up against the pericardium anteriorly.
   Apt to occur as a residual pocket after drainage of generalized effusions.

B. Concealed Effusions—At no place related to the parietes.

1. *Infrapulmonary* or "*Diaphragmatic.*"
   The most difficult to diagnose roentgenologically.

2. *Mediastinal*..... Lying between the lung and the heart, or mediastinum.
Differential diagnosis from mediastinal conditions difficult, but important.

3. *Interlobar* ..... Sites,—
(*a*) in the oblique main fissure.
(*b*) in the horizontal right "middle" fissure.
If progressive, tend to erupt to a bronchus, or to the general pleural cavity.
Three clinical types exist,—
(*a*) Metapneumonic.
(*b*) Tuberculous.
(*c*) Idiopathic.
Very difficult to discover or localize by physical examination alone.

c. Multiple or Multilocular Effusions
Co-existence of several of the above.
May be completely separate, or may communicate.
Of clinical importance, as each requires to be individually drained.
Separate pockets may contain different kinds of fluid.

Encapsulated effusions present a more difficult differential diagnostic problem than the free effusions, owing to their extreme variety. The diagnosis will often have to depend, ultimately, on exploratory aspiration of any suspected mass, after accurate localization roentgenologically. Lung abscess may produce somewhat similar appearances, but is intrapulmonary, has usually an irregular margin where it merges with the lung tissue, and may have a small air pocket. Plaques of dense pleural thickening arising as residues of old empyemata, are difficult to distinguish until they commence to show signs of calcification. They usually, however, lack the smoothly rounded contour of the actual fluid pocket. Benign, or relatively circumscribed malignant tumours of the pleura will practically always have to be differentiated by the absence of any causal history for an empyema. Most other lesions of the lung, tuberculosis, malignancy, syphilis, and the like, have their own identifying appearances, but here again, we have considerable difficulty where two lesions co-exist. One minor point to note is to avoid confusing shadows of extrathoracic masses, as seen in posteroanterior films, for pleural densities.

Empyemata, if untreated, may absorb completely, leaving no trace. This occurs, though rarely, even with thick, purulent exudates, especially if there is a minimum amount of fibrinous plastic formation on the pleural surface. In the absence of spontaneous resolution, partial absorption may occur, and the remainder form a solid, dense, fibrous layer of thickened pleura, which ultimately calcifies. Such calcified plaques are common, and are exemplified by Figure 12. A rare example of complete pleural calcification is shown in Figure 13. With such a fibrosing or calcifying process, there occurs a bunching together of the ribs at the site of the lesion, and very frequently, a matting of the diaphragm across the costophrenic angle to the parietes, distorting and fixing the diaphragm; both of these are diagnostic points strongly suggestive of an old pleurisy.

Ordinarily, however, if empyema be left untreated, or if treatment prove ineffective, the disease goes on to the development of a chronic stage. The fluid may persist in closed pus pockets, and as such, act as foci of toxic absorption, and as a cause of vague ill-health. Much more often the cavity opens either into a bronchus, or on to the surface, or is opened, and persists for some reason or other. This results in a constantly or intermittently draining cavity with a persistent sinus.

In the examination of these cases, attention has to be given to the visualization of such cavities, and to the determination of their extent. This cannot be done by simple chest roentgenograms alone, as one has no method of determining the relative amounts of pleural thickening, and of fluid. It is necessary to inject the cavity with a contrast medium. There are three good media in use; lipiodol, or lipiodine, is certainly the most satisfactory medium. It can be diluted by equal quantities of olive oil or sesame oil; the

resultant 20 per cent solution affords ample density. Even so, however, in cavities of any size, this is an expensive method. A 20 per cent solution of iodoform in sterilized sweet oil acts very satisfactorily, is easily made, and may possibly have a therapeutic value. Where neither of these is available, the ordinary water or water acacia emulsion of barium sulphate, as used for gastric fluoroscopy, is quite satisfactory, if sterilized. The various silver, or sodium iodide solutions and their like, may have some irritant action, and their use is not to be recommended.

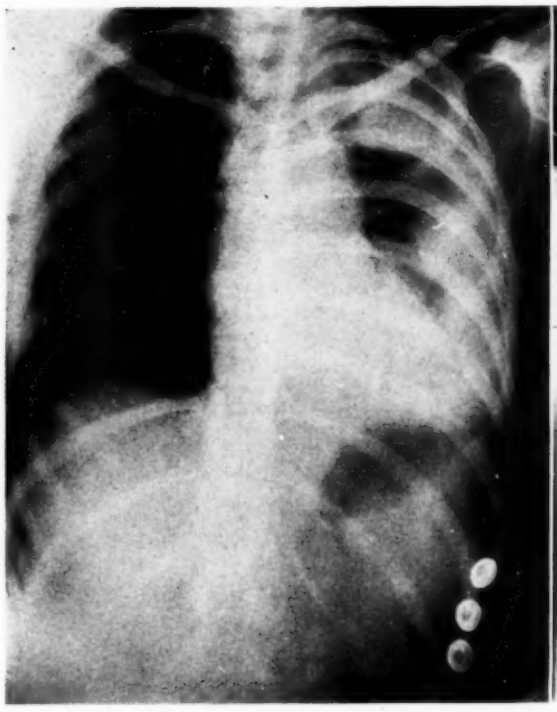

Fig. 11. Loculated empyema with multiple pockets. Separate drainage had to be established for each pocket.

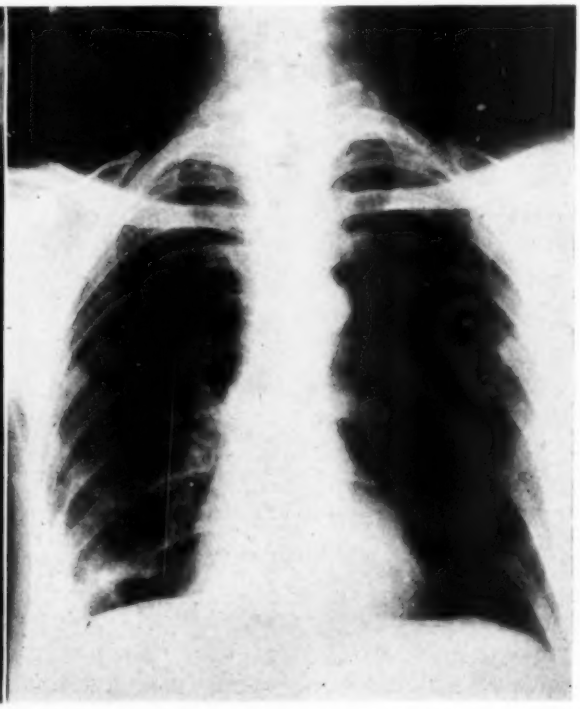

Fig. 12. Calcified pleural plaque in right base. Three months history, many years ago, of a severe illness called "pleurisy."

Before filling, a cavity should be drained for a short time with the sinus in the most dependent position. The patient is then turned with the sinus upward, and with all necessary aseptic precautions, a fine rubber tube, attached to an ordinary 20 c.c. syringe, is passed as far as possible into the sinus. Any residual pus is aspirated, and then the cavity is filled slowly with contrast medium, until it overflows around the tube. The tube is then withdrawn, and the opening sealed over completely with collodion and absorbent cotton, before the patient is moved. As soon as the collodion has set, the patient can stand up, or even lie on the side of the lesion, without any escape of medium. The usual posteroanterior and lateral rays are then taken. In addition, however, a film should be exposed on the Potter-Bucky grid, with the patient in a position such that the sinus and the cavity are nearest to the film, using a lateral or oblique position as may be necessary. This not only gives a much clearer picture of the filled cavity, but also gives good visualization of the condition of the ribs at that point—an important point. Figures 14 and 15 represent two such visualized cavities, one posteriorly, and one laterally.

There are many causes for the persistence of a cavity. Of these, the most common is a thickened pleura rendering the walls rigid, and preventing expansion

of the lung (Fig. 16). A frequent concomitant of this, or existing by itself, is the presence of drainage established at some point other than the lowest point of the cavity. Another possibility is the persistence of separate, unopened, unsuspected cavities. Sometimes one finds a foreign body, or a chip of bone at the bottom of the sinus. This is especially likely where there is a long narrow sinus, with no other apparent reason for failure to close (Fig. 15). These various conditions of the cavity may all be demonstrated by contrast filling, as described. Even in the absence of thickened pleura to bind it down, the lung may develop an intrinsic fibrosis which prevents its expansion. Communication between the cavity and a bronchus, either through an erupted abscess or through primary rupture of a loculated empyema, may complicate the process. Sometimes this can be demonstrated by injection of the cavity with lipiodol; at other times, the communication is best shown by lipiodolization of the lungs, via the trachea, in the ordinary way. It should also be kept in mind that the condition of the ribs, or infection of the ribs at the old site of a resection, may be the cause of trouble.

Fig. 13. Complete calcified cast of pleural cavity. Patient had a large empyema fourteen years ago. She was now sixty-four years of age, and had no symptoms whatever.

Fig. 14. Persistent empyema cavity injected with lipiodol. Condition postpneumonic, and persistence due to thickened pleura. Thoracoplasty, with decortication, resulted in cure.

The addition of a pneumothorax, partial or total, to any empyema process, is a common thing. This may occur in closed empyemata, after aspirating. Most commonly, however, in chronic pleural pockets, one finds air in conjunction with fluid, as partial pyopneumothorax. The presence of such air is of value roentgenologically in outlining the extent of any cavity, and in showing the degree of pleural thickening walling it. A characteristic feature of any such pocket is the so-called "fluid level." The upper surface of the fluid moves freely within the cavity and maintains itself horizontally, whatever the position of the patient. By examining the patient in several positions, the whole extent of the wall of the cavity can be accurately de-

termined, and communication between multiple pockets identified. It is also worth noting that in certain cases of free effusion, a replacement of whole or part of the fluid by air, may render visible any associated parenchymal lesions not otherwise demonstrable.

Fig. 15. Persistent empyema sinus injected with lipiodol. Persistence was due to chip of bone in depth of the sinus.

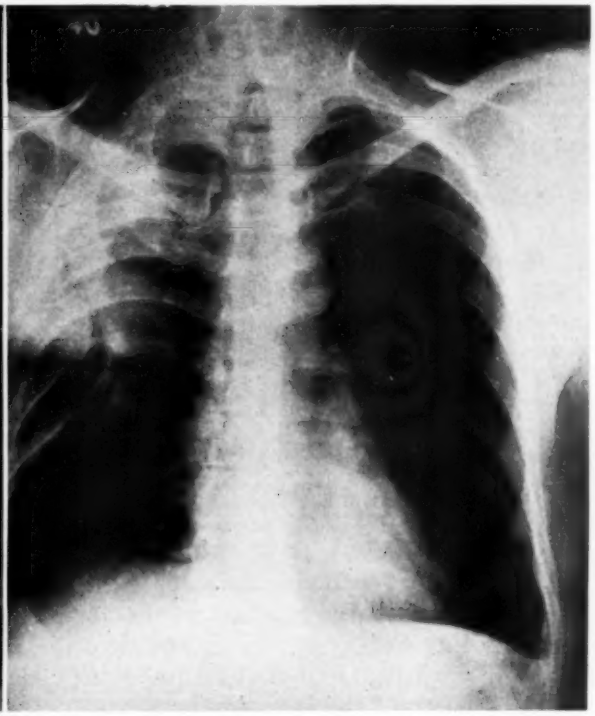

Fig. 16. Old empyema cavity with perfect drainage, but rigid and thickened walls. Condition postpneumonic. and of thirteen years standing.

These, then, are the more common conditions found associated with infection of the pleural cavity. It is probably wiser for the roentgenologist to make as complete an examination as possible, before he takes any cognizance of the clinical facts. He can then make up his mind in an unbiased manner as to what he thinks the conditions are. Only thereafter should he consult with the clinician, who, meantime, has done the same thing without roentgenologic assistance. By a correlation of these two groups of findings with each other, and with the history, it is usually possible to achieve a very accurate idea of what the real state of affairs is in the thoracic cavity.

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The author desires to express his indebtedness to Dr. Marion Laird for translations of 2 and 3.

THREE CASES OF NEUROMA:

CIRSOID NEUROMA OF FACE; NEUROFIBROMA OF STOMACH; POSTERIOR TIBIAL NEUROFIBROMA*

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AMONG the rareties of radiological practice are positive findings in cases of tumor of peripheral nerves. A description of three rare nerve tumors with positive radiological findings should therefore prove of great interest and importance, and, by stimulating more frequent recourse to *x*-ray study in neurological cases, should assist in increasing the frequency with which such tumors are recognized in advance of operation.

CASE 1. EXTENSIVE CIRSOID NEUROMA OF FACE

Figure 1 shows the appearance of the facial tumor of H. D. K., a young man of twenty-six, on June 1, 1915 when he applied to me for examination of a swelling on the right side of the face. The patient stated that he was born with this deformity of the face. At the time of examination the right cheek was large, and the right eye so badly swollen that he could hardly see. All the tissues of the right side of the face were very much infiltrated and thickened. There was also a similar smaller tumor in the right supraorbital region. None of the swellings were painful. At the age of twelve, after having been thrown from a horse, striking on the head, the patient was unconscious for twelve hours. During the last eight or nine years, there had occurred a progressive enlargement of the growth. Seven years before the present examination two operations had been done without apparent success.

Roentgen examination of the skull in the anteroposterior direction failed to reveal asymmetry of the malar bones. Both right maxillae, however, were deformed by the pressure of the tumor, and the molars were distorted so that they pointed directly inward. The bicuspids were deflected to a lesser degree.

The lateral stereoroentgenogram of the head showed several well defined localized areas of decreased opacity of the cranial bones on the right side of the skull. One of these conspicuously thinned areas was located in the parietal bone, two in the frontal bone, and one was apparently divided between the parietal and the temporal bones, the thinned out area apparently not in any way respecting the suture line. There was a distinct clouding of the right maxillary sinus, also a deformity of the upper and the lower maxillae on the right side, which were pushed inward by the mass of the tumor. The thinning of the bone is well shown in the roentgenogram (Fig. 2).

Careful neurological examination by Doctor W. H. Riley failed to reveal any neurological findings which were attributable to the tumor, aside from the defective vision. Examination of the eye grounds showed 20/60 vision in the right eye, 20/40 vision in the left eye. All the intraocular blood vessels showed a hyperemia, this being noted especially in the nerve heads. There was no particular difference between the two sides.

In considering the plan of treatment, it was decided to avoid hot water injections, at least until a histological diagnosis could be established, and to attempt the reduction of the tumor (1) by surgical removal of the large tumor beneath the right malar bone and the smaller tumor above the right eye, and (2) by treating the remnants of the tumor and the remainder of the involved areas of skin by roentgen-ray therapy, using what were then considered the harder rays and heavy doses, through a filter of 4 mm. of aluminum with an added 3 mm. of sole leather.

On June 3, 1915, we removed from above the right eyebrow what appeared to be a vascular tumor the size of a walnut. The tumor was adherent, on its under surface, to the periosteum of the supraorbital arch. The upper surface of the tumor seemed to be intimately associated with the skin in such a way as to make it difficult to find the line of division between tumor and skin. At the same operation there was removed from beneath the right malar bone an irregular globular mass 7 cm. in diameter, intimately adherent to the periosteum of the upper alveolar arch and to the anterior surface of the superior maxilla.

*Submitted for Publication February 27, 1930.

After three weeks, a further reduction of the tumor was attempted by means of the roentgen rays. The skin overlying the affected area was

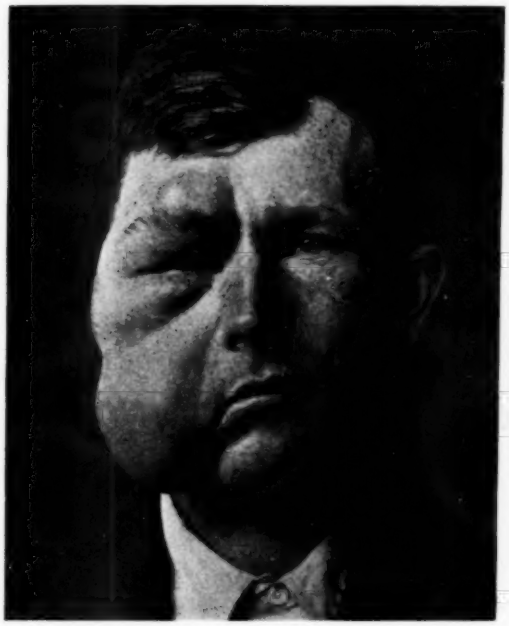

Fig. 1. Preoperative appearance of Case 1. Cirsoid neuroma.

so divided as to afford six portals of entry. Not only the face, but the areas of the skull which were shown by the roentgenograms to have been thinned, were subjected to roentgenotherapy. At first it was thought that a diminution of the facial swelling could be appreciated; but after some months of routine intensive therapy with the hardest rays then obtainable and with the filter above mentioned, this form of therapy was abandoned.

On November we returned the patient to the operating room for removal of as much as possible of the remaining tumor tissue. No recurrence having been observed since the last operation, we felt encouraged to do as radical a removal as possible, especially in view of the pathological report from Dr. A. S. Warthin. The result was fairly satisfactory from a cosmetic standpoint (Fig. 3); at any rate the patient expressed himself as well pleased.

The microscopic examination of the tissue by Dr. Warthin resulted in a report of a vascular fibrous tumor containing chiefly non-medullated nerve fibers, with muscle fibers in and between nerve bundles (Figs. 3, 4).

This form of tumor, to which the name cirsoid neurofibroma or plexiform neuroma has been given, is practically always congenital. The upper eyelid, the cheeks, the region of the

Fig. 2. Extensive thinning of the cranial bones of Case 1.

ear, the back and the breast are the principal sites of this type of neuroma, which often causes curious deformities, as in the nape of the neck, the face, the extremities and the external genitals. Bruns was first to apply the term cirsoid to this type of nerve tumor, composed of plexuses of convoluted strands or cords held together by a soft, loose, fatty connective tissue. Although it may be found as a more or less circumscribed tumor-like mass, it may present, as in this case, no capsular or other limitation, perforating the neighboring fasciae, penetrating the muscles in all directions, adhering to the periosteum, and lodging in grooves or foramina in bone, as the flat bones of the skull or the roof of the orbit. It may be very intimately connected with the overlying skin which may be much thickened (Alexis Thompson). All the foregoing characteristics were presented in the case herewith reported. Of a series of 58 cases reported by Thompson, 18 occurred in the temple, forehead and upper eyelid; 14 in the posterior part of the neck and behind the auricle, 4 on the nose and cheek, 5 in the lower jaw and anterior half of the neck, 8 in the breast and back, and 9 in the extremities.

In spite of the apparent futility of the radiation therapy in this case, as judged by

the result in 1915, the afterhistory of the case and the clinical results in other cases of fibromatous tissue under roentgenotherapy, lead us to suspect that after all it may have been the roentgenotherapy which has been chiefly responsible for the failure of the tumor to recur. The patient was alive and well according to a letter received in the fall of 1929, although he has not presented himself for a photograph of his present appearance. No further treatment with *x*-rays has been administered in the intervening fifteen years. Fig. 5 shows the final result in December 1915.

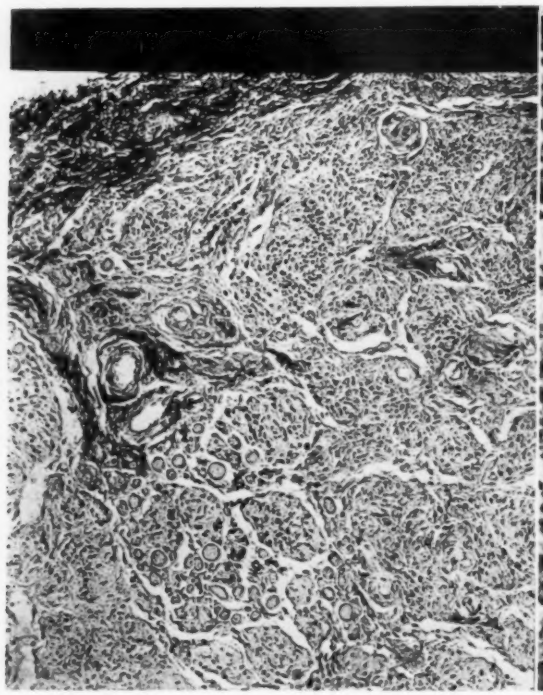

Fig. 3. Microphotographic appearance of cirsoid neuroma of Case 1, showing nerve trunks and muscle fibers in the mass of nerves (low power).

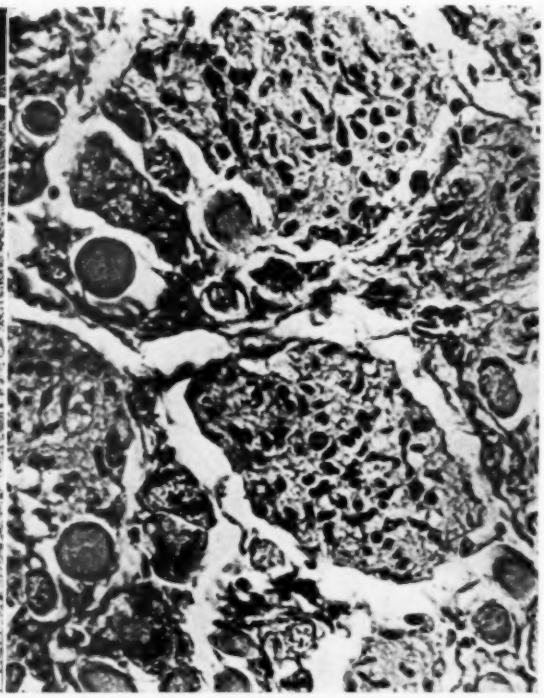

Fig. 4. High power view of histological structure of cirsoid neuroma, Case 1, showing muscle fibers in and between nerve bundles.

CASE II. GASTRIC NEUROFIBROMA

Mrs. M. L., age 47, presented herself in May 1926 for relief of indigestion and epigastric pain. The clinical symptoms led to a radiological examination of the gallbladder by Graham's intravenous method which resulted in a diagnosis of multiple non-opaque gallstones, practically filling the gallbladder. The gallbladder appeared to be of unusually large size (Fig. 6, a). A gastrointestinal *x*-ray study was also carried out without any report of a pathological finding. A small, shallow filling-defect, was seen on the greater curvature near the pylorus, having the appearance similar to that noted in some cases of large gallbladder compressing the wall of the stomach; and in this case it was thought to be due to the pressure of the large gallbladder

Fig. 5. Appearance of Case 1, at close of surgical and *x*-ray treatment in 1915. No essential change to the present date.

(Fig. 6, b, c, d). The filling-defect seemed to be more or less ovoid and with borders that gradually faded into the density of the gastric shadow, thus suggesting an extrinsic rather than an intrinsic cause.

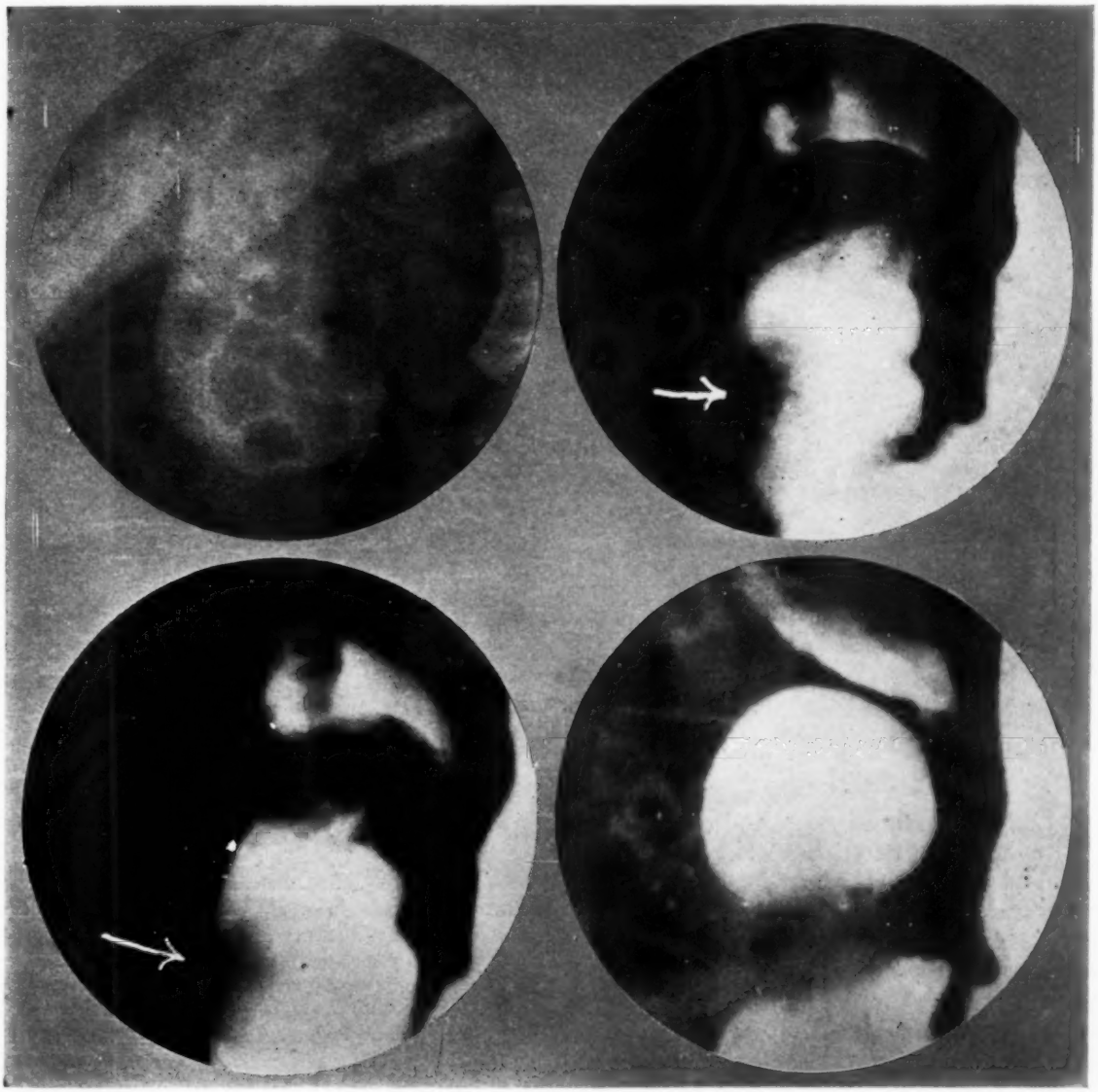

Fig. 6. Case 11. (*a*) Cholecystogram showing multiple non-opaque gallstones. (*b*) and (*c*) Faint filling-defect in greater curvature of stomach shadow, really due to gastric neuroma on posterior wall, but erroneously interpreted before operation as being associated with pressure from the stone-filled gall-bladder. (*d*) Another film from the same series showing a high grade of spasm in the stomach at the site of the neuroma.

At operation by Dr. W. E. Shackleton, of Kalamazoo, Mich., on May 11, 1926, a moderately distended gallbladder filled with stones was removed, and on examination of the stomach there was found on the posterior wall a tumor mass near the pylorus, 6 cm. in diameter, without any palpable glands in the neighborhood. The tumor mass was resected from the posterior wall of the stomach and the wound closed in the transverse diameter. At the time of operation the mass was thought to be malignant but Dr. Warthin's report on the histology of the tumor was that of a neurofibroma, primarily a disturbance of development (Fig. 7).

G. Lardennois[1] in 1928 reported a gastric neuroma removed by gastrotomy but which before operation was reported by Henri Béclère as a benign tumor on the basis of the roentgenographic findings. A woman of 58 gave a history of a gastric hemorrhage, followed

by melena of definite grade. The patient then recalled that on previous occasions she had noted dark blood in the stools. She had never vomited and there had been no gastric disturbance of a painful nature. Following the definite hemorrhage with black stools, there continued to be a leakage of blood at the site of the tumor as shown by constantly positive occult blood findings in the excreta. On a tentative diagnosis of duodenal ulcer, Béclère made a radiological study resulting in the finding of a clear zone, giving the impression under fluoroscopic manipulation of a polypoid growth implanted in the gastric wall. A re-examination confirmed the opinion that one dealt with a benign tumor. Operation confirmed the opinion. The author removed from the anterior wall of the stomach in its middle third a tumor the size of an apricot which on histological examination proved to be a peripheral glioma, included within the thickness of the muscular wall. The bleeding had its origin in a mucosal ulcerated area in the most exposed part of the prominence of the gastric wall caused by the tumor.

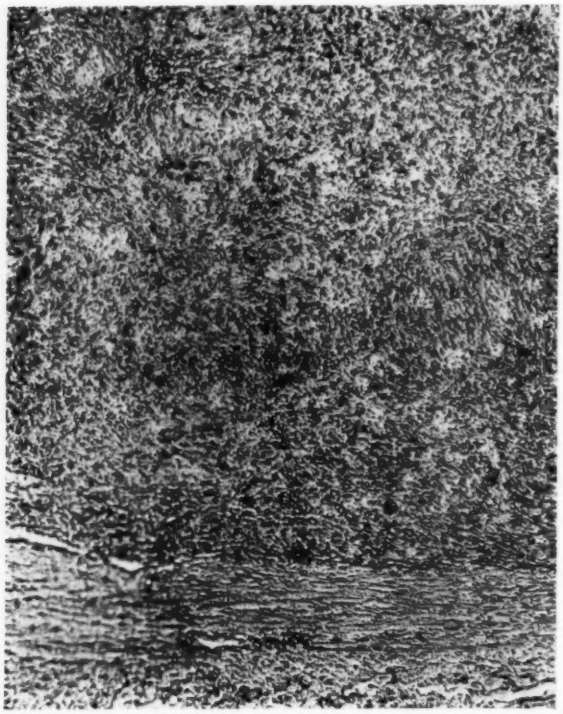

Fig. 7. Microphotographic appearance of the gastric neuroma of Case II.

Statistics from the Mayo clinic indicate that there occur one benign tumor of the stomach to about eighty malignant growths. From 1922 to 1927 Balfour and Henderson[2] were able to report 38 cases of benign gastric tumors.

Our failure to recognize the definitely gastric origin of the tumor in our Case II, illustrates how important it is to commence every radioscopic study of the stomach by careful palpation under the screen at once after the first swallow of the opaque meal, for when the full meal has been ingested it is much more difficult to recognize a tumor, especially when located on the posterior wall.

Fig. 8. Roentgenogram of left leg, showing normal bony structure, and a soft tissue tumor (at arrows) between the bones and the Achilles tendon, proved to be a neurofibroma of the posterior tibial nerve. The tumor caused definite local displacement of the calcified posterior tibial artery.

CASE III. NEUROFIBROMA OF THE POSTERIOR TIBIAL NERVE

This case, though previously included in a report[3] on false peripheral neuromata, is referred to here because of the interesting radiological finding. Mr. A. P., age 63, came to me in August,

1927, for treatment of a neuritis involving the left leg and foot. There was found a rounded swelling about 2 cm. in diameter, on the left leg just above the ankle, most evident on the internal aspect of the member. The tumor was movable laterally to a limited degree, but not at all in the long axis of the leg. It was not attached to the skin, and was not sensitive to gentle pressure. Pinching or hard pressure caused intense pain to shoot into the foot. The lump was first noticed about twenty years before admission, and was much smaller then than at the time of examination, having undergone gradual though slow growth. Roentgen-ray study (Fig. 8) did not reveal any abnormality of the bones of the leg or ankle, but it did show distinctly the presence of a soft tissue tumor between the shadow cast by the Achilles tendon and the bones of the leg, causing a local displacement of the neighboring calcareous posterior tibial artery, the soft tissue shadow corresponding accurately to the palpable painful tumor. The findings led to a diagnosis of neuroma of the posterior tibial nerve.

Under local anesthesia the posterior tibial nerve was exposed through a longitudinal incision on the inner side of the left leg just above the ankle. The nerve was found to surround a well-encapsulated, fusiform tumor about 3 cm. in diameter. The sheath of the nerve was split longitudinally and the tumor enucleated with very little traumatism to the nerve tissues.

The pathologist's report on the tumor indicated a pure neuroma in some areas, neuroglia in others. No ganglia cells were found, although there were atypical neuroblasts. The nerve fibers were chiefly nonmedullated. Throughout the tumor there were large and atypical lumphatics and blood vessels. Some bloodvessels showed some hyaline change in the walls, a cylindromatous change. There were also areas of myxomatous tissue scattered throughout the growth and some pigmented areas from old hemorrhage. The general structure was that of a congenital disturbance of development resembling the cirsoid neuroangioma (Warthin).

SUMMARY

Three cases of nerve tumor, of the neurofibroma variety, two of them having characteristics resembling cirsoid growths, are reported to illustrate the value of the roentgenological study in a field where *x*-ray aid is not ordinarily sought.

In an extensive cirsoid neurofibroma of the head and face, the roentgen study revealed extraordinary thinning of the cranial bones and distortion of the upper and lower jaw and the teeth of the affected side of the face. The long duration of apparent freedom from recurrence following combined surgical and roentgenotherapeutic attack fifteen years ago, in spite of recurrence and continued growth following previous treatment by surgery alone, suggests that it is worth while treating such neuromas by *x*-ray or radium alone or as a supplement to surgical intervention according to the case.

A fairly large neurofibroma of the posterior wall of the stomach near the pylorous was missed in the pre-operative *x*-ray study because of the spectacular finding of a large gallbladder filled with stones and the assumption that this large gallbladder was the cause of the filling-defect in the greater curvature aspect of the stomach near the pylorous in reality due to the neuroma.

A neurofibroma of the posterior tibial nerve was well demonstrated in the roentgenogram by its faint but well-defined shadow in the soft tissues of the leg, and especially by its displacement of the posterior tibial artery rendered visible by an unusual grade of calcareous degeneration.

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NOTES ON THE ETIOLOGY OF CANCER*

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NEVER before in the world's history has the subject of cancer been under closer scrutiny than at the present time, for practically every educational group of higher intelligence the world over is making a sweeping investigation of all the available data which may have bearing upon the whole cancer problem. The writer, therefore, takes the liberty of submitting a few notes on this subject, some of which are purely empiric, but are gleaned nevertheless from a personal clinical experience with cancer over a twenty-five year period, and upon a fairly large representative cancer group.

What influence has mechanical irritation upon the production of cancer? In the writer's opinion, the importance of this has been greatly overestimated, even to the point of assumption that its part in the production of a latent cancer may be considered negligible. With chemical irritation we believe that we can also take a similar though somewhat modified view. This whole subject is still so insecure that one hesitates to inject personal opinion, yet withal is so important that this phase cannot well be omitted from any article dealing with the theory of cancer causation.

Our partner, Dr. O. N. Meland, offers the following discussion on the effect of chemicals:

"What effect chemicals have in the production of cancer is a difficult question to answer offhand. Certain it is that only a very few individuals who are exposed to chemical irritants develop malignant disease. Observation of those who are engaged in industries where the skin is subject to the products they are preparing, shows that the products of coal tar distillation seem to be one of the offending elements.

"Thus, we have the paraffin cancers in the paraffin workers, the chimney sweep's cancer due to scrotal irritation from soot, and of workers engaged in these pursuits, only a small fraction develop malignant skin lesions, and those come after a long period of exposure.

"Experiments on mice and rats reveal that a small number will develop skin cancer after prolonged painting with tar, but rabbits and guinea pigs, when subjected to the same chemicals, practically never develop anything suggestive of a surface cancer. This leads us to believe that whatever rôle the chemical plays, it must be a minor one, or rather it is merely an exciting agent. In other words, the soil must be prepared before irritation will bear fruit.

"What the underlying factor is, no one knows, but it probably is hereditary in nature, as Doctor Maud Slye has demonstrated in her work of twenty years with mice. Whether the irritant factor is to be followed by cancer will depend upon what the cell has hidden within itself. If a susceptibility exists and has been handed down through the germ plasm, then a long continued irritation by any one of a variety of chemical or physical stimuli may be followed by cancer in these unfortunate individuals."

Combined mechanical and chemical irritations will without question so damage cell structures at the point of contact that any infection may well prosper there, but what have these factors to do with the residual, hereditary, or sleeping cancer cell without which, in the writer's opinion, no cancer growth could prosper? If this view should prevail, then our time spent in seeking a specific germ, or by the same reasoning a curative or preventive serum from such, is wasted. This does not mean that carcinoma is considered to be in the nature of an infection, but that infection

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plays a very important rôle in the incidence of cancer. It is therefore obvious that its removal together with its cause, materially improves the patient's condition and renders much more probable the successful destruction of the cancerous process itself.

Can one draw any conclusions as to the cause of cancer from a study of the tissues in the regions where cancer most frequently originates? Let us briefly consider this question in the ratio of its selectivity: in man, the face, lip, tongue and stomach; in woman, the breast and the uterus.

In the skin, the face is the location of choice for epithelioma. Here irritation of all sorts, it must be admitted, is more probable than on the covered and protected parts. Even the hands are less exposed, as they are frequently in a man's pocket or in a woman's glove. Therefore, the face is always in the weather and meets all external attacks from the front. Hence, prominent features of the face are usually the seat of local abrasions, irritations, infections, and then epithelioma.

How much do the irritating factors in this illustration contribute to the development of epithelioma? If the writer's opening statement be accepted, that irritating factors play only a minor part in the role of cancer production, how can one reconcile this to the apparent fact that cancer of the skin occurs most frequently upon the face, and the face is almost continually subjected to the irritating factors enumerated?

Conversely, we know that approximately ten percent of the human race acquires cancer. However, this ten percent includes cancer distributed in all parts of the body. Hence, we must rightfully assume that much less than ten percent of all cancer, and even less than five percent, actually originates in the skin of the face.

If, therefore, irritation is considered an important agent in cancer production, why does not the other ninety-five or more percent of the human race, whose skin is equally exposed to irritation, develop cancer? It is this large discrepancy in figures which cannot be lightly laid aside when one is attempting to analyze the brief available facts already accumulated concerning cancer.

The daily shave of men is certainly a decidedly irritating factor where the skin is constantly bruised and frequently injured. Yet, we have no evidence to show that the ratio of epithelioma is greater among the shaved than the unshaved. Similar irregularities to which the tongue is subjected may have a strong bearing upon the incidence of cancer in this organ; yet here we have the added irritation with food products of extreme temperatures and of a kind and degree never intended by nature as fit for human consumption. Surely the external skin is never subjected to such unnatural stimulation, and if this were a predominating influence in the production of cancer, nearly every male individual, and not a few females, would develop epithelioma of the lip, tongue, or mouth.

The lower lip in man is predominant in primary cancer, which ordinarily begins at the junction point of skin and mucous membrane; possibly this may be a locus minoris resistentia or a weak spot in the fusion line of the respective epithelial cells. Here we have present not only the external irritation alluded to, but also such injury as may arise from careless mouth hygiene, use of tobacco, carious teeth, and other insults.

We may as well here include the stomach. This organ chooses the region of the pylorus as its objective for carcinoma. At this point the mucous membrane of the stomach fuses with mucous membrane of the duodenum; still cancer does not select this fusion point as its most frequent habitat but seems to invade more frequently the lesser curvature proximal to the sphincter. In the stomach, however, we have two distinct but powerful irritating factors—the muscular or mechanical, and the secretory or chemical. These, together with abnormal food contacts, make a formidable array of irritants which

would soon decimate the human world which we now term civilized, if they alone were the causative agents of cancer.

As has already been pointed out, cancer of the skin in early womanhood is relatively rare, much more so than in early manhood. In woman it is difficult to say which organ exercises the predominating influence the breast or the uterus. From the literature, one would adduce that the two run almost parallel. In our own experience, we are certain that we saw more uterine than breast cancers in the earlier years of our work, while during the past decade the breast cases have been steadily increasing in number so that at the present time the breast cancer cases outnumber the uterine cases. This is perhaps due to the fact that in former times the early bleeding from the uterus caused more alarm and brought the patient to the physician, whereas now women are being taught to bring the early lump in the breast to the attention of their medical adviser.

In child-bearing women, the cervical canal more than any other pelvic part is subjected to severe strain, irritation and injury; yet primary carcinoma prefers to take its origin from some part of the cervical lip, and by no means does it routinely arise from the seat of a cervical tear. In the corpus uteri, it is questionable whether child-bearing is a priori an irritating cause of cancer. We ourselves believe that a degenerating fibroid is a greater factor than formerly believed. Again, we have to ask ourselves, if irritation has a direct bearing upon cancer causation. Why are ninety-seven percent of child bearing women immune, assuming that we allow the large and arbitrary three percent basis for cancer of the uterus out of the gross total of all cancer which involves the human race? The same reasoning can be applied to cancer of the breast.

Theodor Boveri's "Chromosome Theory" is one of the most ingenious dissertations on the morphology of cancer which we have seen. Throughout the little book, so interestingly written, are many convincing statements, and the theory propounded is not unreasonable and it opens up a wide field of speculation. It seems to have a sound basis and can very well be harmonized with the hereditary theory of Doctor Maud Slye. The latter is, in the writer's opinion, the one outstanding contribution to the incidence of cancer which has successfully withstood adverse criticism. The test of time also seems corroborative.

If we can disregard irritation alone as a primal cause of cancer, may we not assume that two additional factors have to be reckoned with. First, that the types of cancer under discussion show a predilection for a junction point of two epithelial structures, and second, the combined action of constant irritation and physiological function at such points brings on early senility of the cells in these parts so as to invite cancer development.

Finally there seems to be a tendency to turn toward the endocrine system which may after all be the sole custodian of the secret. Here we have the complex mechanism which reigns over the rise and fall of the whole complicated cellular structure, and it is sincerely to be hoped that further studies along this line may bring us nearer our goal.

ROENTGENOLOGY OF THE ACCESSORY NASAL SINUSES*

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THE passing decade has proved the importance of eradicating foci of infection. The teeth, the tonsils and the gallbladder have been intensively studied, that the presence of foci might be discovered; and now we find the attention of the medical man, the otolaryngologist and the radiologist centered upon the accessory nasal sinuses. In this brief communication it is our wish merely to recall to attention a forgotten technique, and not to enter into the statistics of a considerable series of cases studied in this manner, nor to undertake a discussion of gross and microscopic anatomy. This we propose doing in a later communication.

The roentgenologist made a large effort to study sinus disease even before he obtained any cooperation from the otolaryngologist. This field, in common with all other fields in medicine, could not be studied by any one specialized group. There must be an active and whole hearted cooperation between all who are concerned, if any important work is to be done. It is only during the past few years that this essential cooperation has existed.

From the mass of ideas of the past to the present time there has come no technique which satisfactorily demonstrates pathology in the accessory nasal sinus. We then arrive at the point where we must choose the procedure which meets our needs best. This each roentgenologist does, and, in consequence, there are more variations of procedure in the study of sinus disease than any other in roentgenology.

The writer has gone through the evolution of this subject along with others, having worked with flat, posterior-anterior, and lateral films, the occipito-mental position; with the 107° angle of Granger, without being able to give to the otolaryngologist the information which he desired. We were able to give fairly accurate information regarding the antra and the frontal sinuses but practically nothing concerning the extent of involvement of the sphenoids or the ethmoid labyrinth. The occipito-mental position for the study of the sphenoid shows very little except increased density because of the multiplicity of overlying structures.

FIG. 1. Shows position of head for films of the antra.

Granger's method is, in his hands, very satisfactory, but this position, it seems to us, is a special study and not satisfactorily adapted for routine examinations—a requisite which must influence the selection of a method.

We attempted to modify Granger's work by making three films in the postero-anterior position, one film at Granger's 107° angle, one at an angle of 90° and still another at 35°. Each of these films could be utilized in the stereoscope. This change gave us more information than flat films, but shadows of structures were present which we could not study properly and the clinicians' verdict was that the method did not give them the information they desired.

* From the Departments of Radiology and Otolaryngology of the Portland Clinic. Submitted for publication February 27, 1930.

In 1925 we began to work with the Rhiese technique. This technique has been rediscovered at varying intervals since its original description and is an oblique exposure of the head. The patient's head is placed on the exposure tunnel with the sagittal plane of the skull at an angle of about 23° with the tunnel. This elevates the occiput and places the external orbital margin, the nose and the chin in contact with the tunnel.

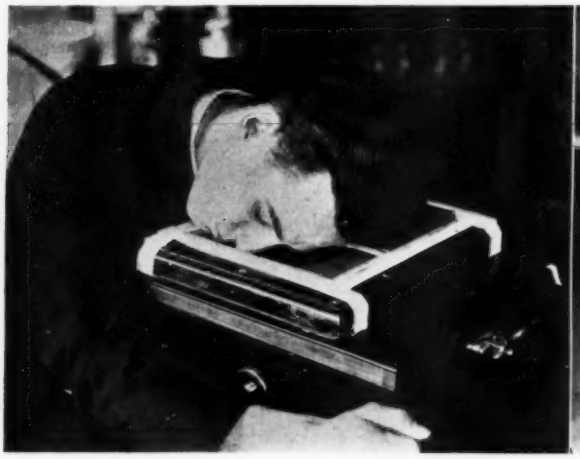

Fig. 2.

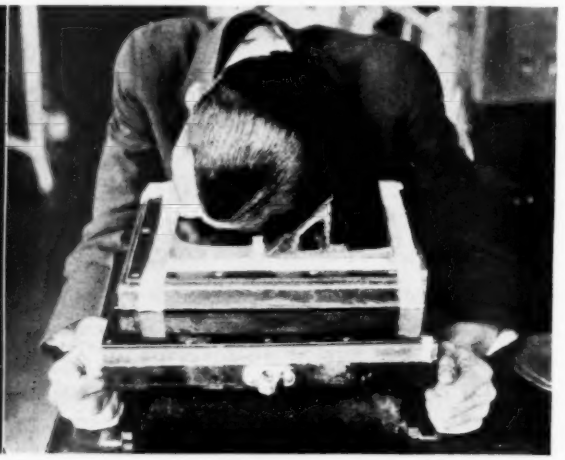

Fig. 3.

Figs. 2 and 3. Show the position of the head and its relation to the sinus board in the Rhiese position. The position is reversed for the left side.

The plane of the small cone and of the exposure tunnel are parallel. The central beam is directed from the opposite parieto-occipital region through the orbit which is in contact with the exposure tunnel. Both sides are done stereoscopically. This position projects both the ethmoids and sphenoids through the orbit. One sees the optic foramen on the same side, the superior and posterior margins of the sphenoid, and the ethmoid labyrinth. The ethmoids are overshadowed by the sphenoid and the ethmoid cells from the opposite side, but one is per-

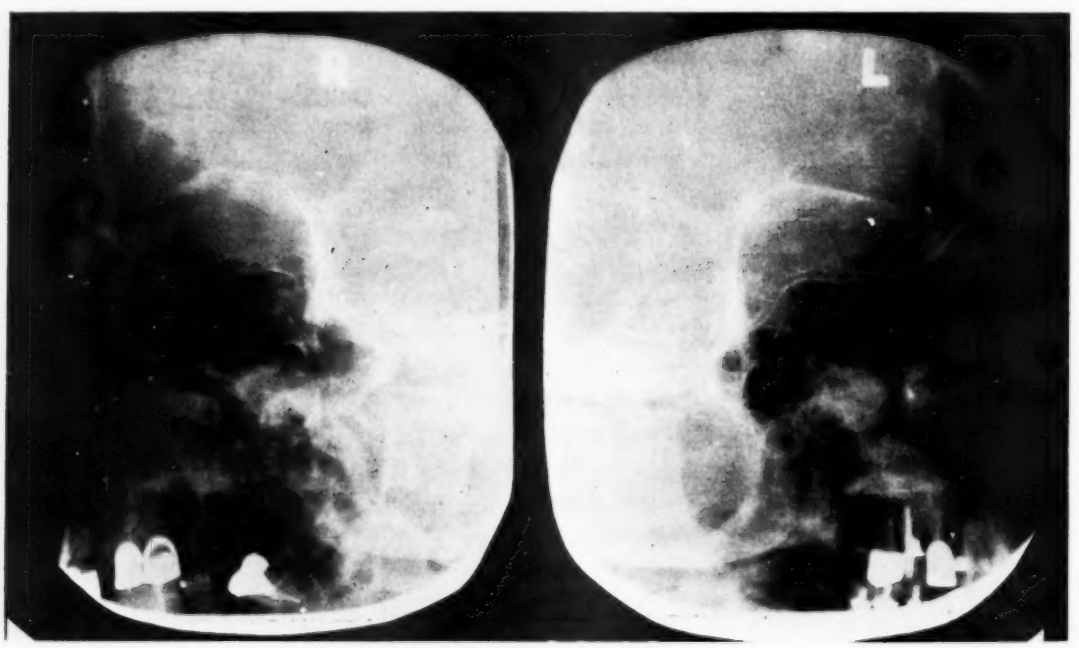

Fig. 4. Shows the normal ethmoid labyrinth beneath the orbital plane, the sharp clear borders of the sphenoids anterior and below the optic foramen.

mitted to separate these structures by the use of the stereoscope.

It is obviously impossible for the roentgenologist even to translate into terms of roentgen pathology the anatomical pathology present in the sinus, unless he can follow the patient to the operating room or have the benefit of a postoperative conference with the surgeon. At this conference the surgeon must describe minutely the changes which were present and he and the roentgenologist must fit these changes to the varied structural distortions noted on the films. This process of education each roentgenologist must go through if he is to equip himself to give satisfactory opinions. It is not sufficient that he should have the necessary mechanical equipment.

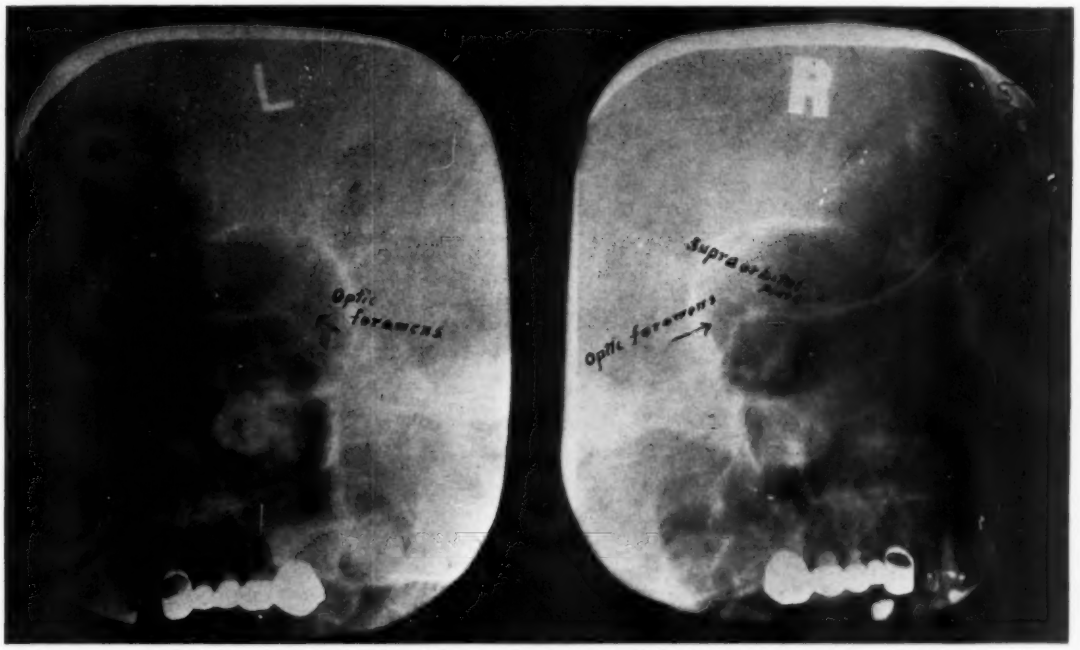

Fig. 5. Shows a chronic hyperplastic ethmoid and both sphenoids. Note the blurring of the margins of the sphenoids and the moderate thickening.

The uninvolved sinus contains air; shows no degree of opacity; the margins of the cells are sharply outlined. We are all familiar with the appearance of the uninvolved antrum and frontal. The ethmoid labyrinth, as shown by the Rhiese position, when uninvolved, will demonstrate the individual cells of the labyrinth containing air and having sharp, clear-cut margins, while involved cells will show a definite blurring of the intracellular trabeculae, just as seen in studying the mastoid structure.

The sphenoid, uninvolved, is well illuminated and the posterior and superior borders are sharp and clear. The involved sphenoid, may or may not show a density, but the margins will be blurred or thickened.

In study of these, or for that matter, any sinus film, there are two changes from the normal: First, *an increase in density*, which may vary from a change so slight that it is barely perceptible to a complete opacity. This type of case, however, is one in which nasal examination reveals to the otolaryngologist unmistakable evidence of disease and films are requested principally that the anatomy of the sinus and the extent of involvement may be determined. Second, *slight change in structural characteristics*. This is the type of case in which the internist finds evidence of infection. The patient gives but meager subjective symptoms of sinus disease; and the objective evidence, at nasal examinations,

is not definite. These are the cases that the roentgenologist must prove or disprove if he is to give a real service. To do this we must have films which are technically as nearly perfect as possible—films made in a position which will demonstrate to the maximum degree the sinus anatomy; and we must be thoroughly familiar with the roentgen findings in the normal sinus.

In this type of sinus involvement the changes may be only a blurring of the normal sharp, clear borders of the antra, frontals and sphenoids, and of the sharp, intracellular trabeculae of the ethmoid labyrinth; or there may be a definite thickening of the margins and a lack of ethmoid structure. It is the careful study of structure and detail that enables us to give a valuable opinion.

There are many times that our routine examination must be supplemented by the use of some cantrast media, for instance lipiodol. In the selection of position for this examination we can find no reason to discard either the Rhiese or Waters positions, for here we have an opportunity to study all the sinuses in both the anterior, posterior and oblique positions. Frequently we are able to observe filling defects on the posterior wall, in the Rhiese position, that are not evident in the antero-posterior position.

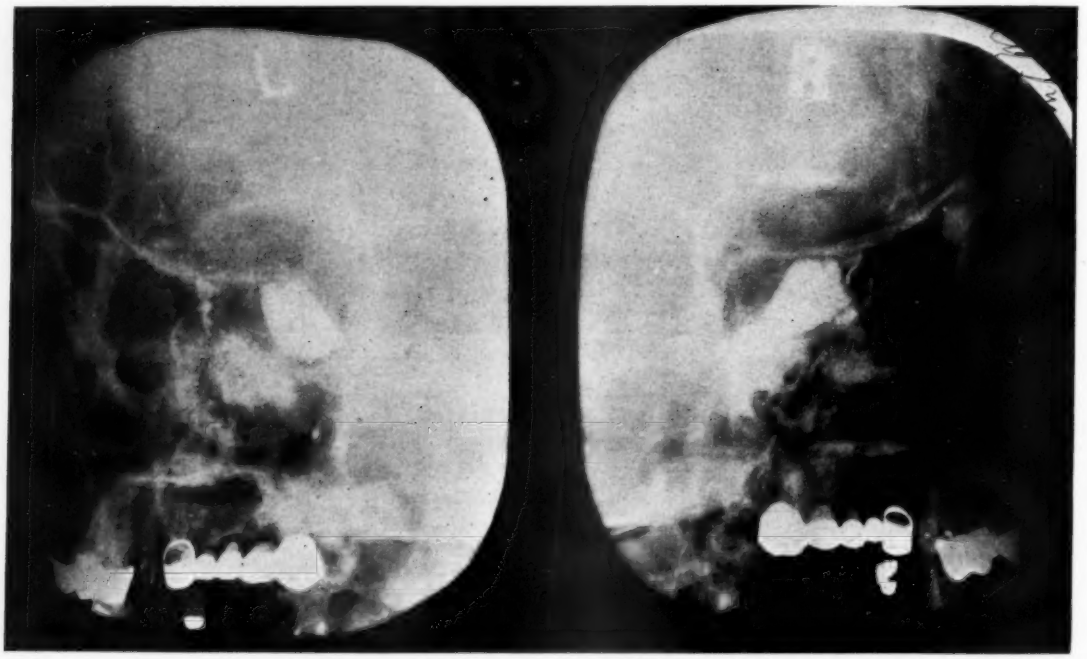

Fig. 6. Same patient as shown in Fig. 5, with the left sphenoid injected. Note the space between the lipiodol and the bony margins, and the relative positions of the two sphenoids in both views.

Summary. Experience with other methods of sinus examination has brought us to the firm conviction that, at least until a more satisfactory method is devised, the Rhiese position, when stereoscopic films are made, is the most valuable for the routine study of the sphenoids and the ethmoids, and that flat or stereoscopic films in the postero-anterior direction after the manner of Waters gives sufficient dependable information regarding the maxillary antra and the frontal cells.

It has also shown us that the study of margins and structures is of greatest importance; that each individual working in this field must study carefully the anatomical pathology of the cases operated which he has previously studied radiographically; and, lastly, that dependable diagnoses are obtained only when the otolaryngologist and the roentgenologist study the cases together, making a complete opinion from the clinical and roentgenological evidence available at their consultation.

A NEW COMBINED TECHNIC FOR RADIOLOGICAL EXPLORATION OF THE GALLBLADDER

M. Roses Artau, M.D., F.A.C.P.

SAN JUAN, PORTO RICO

After two years of careful observation, I have reached the conclusion that the usual technic for the exploration of the gallbladder with and without the administration of iodeikon or one of the other preparations utilized for cholecystography may give rise to error, or to doubts which are as prejudicial as errors.

Once the roentgenogram has been made without the previous administration of iodeikon, one either sees nothing or makes out a dark shadow with uncertain contours or he attempts to define the position of the organ by a crescentic deformity of the duodenal bulb in case a barium meal has been given simultaneously, with the result that the flat roentgenogram often proves to be a problem in which all the other problems are combined without clearly setting forth anything.

Sometimes one obtains clear shadows of gallstones, negative or positive, and at other times one obtains the shadow of the gallbladder by virtue of the characteristics of the bile which it contains or the roentgenological conditions of the gallbladder walls; but always one is involved in doubt. Above all one is impressed with the insecurity of the procedure. Bile plus the iodeikon is sometimes sufficient to hide the gallstones.

Making various observations with gallstones of different morphology, dimensions and chemical nature, placed within a small parchment sac, between water bottles equivalent to the coefficient of absorption of the walls of the body, and having obtained roentgenograms with satisfactory technic, it has always been possible for me to obtain sufficient shadows to indicate the presence of the stones. Filling the little sac with bile of various characteristics on various observations nothing appeared or one was simply able to make out the shadow of the artificial gallbladder, which gave one information regarding its position, size and morphology. Gallstones were only visible when they were of cholesterine or bilirubin plus calcium.

These observations suggested to me a combined procedure which I have practiced frequently with very satisfactory results, and by means of which, morever, it was possible to reach the necessary logical conclusions to sum up these delicate and difficult studies.

Utilizing the non-surgical biliary drainage of Lyon, the gallbladder is emptied and its contents collected aseptically, after which I expose a series of films under certain definite conditions. I then administer iodeikon either by oral or intravenous route. In some cases, I leave the sound in the duodenum exposing the films with it in place, and by it I slowly inject the iodeikon preparation and at the appropriate hours make new films, administer a barium meal and continue my observations while I do a chemical and bacteriological study of the bile.

The work once done I find myself in condition to establish conclusions concerning the following points:

1. Permeability of the common duct and a functional test.
2. Cytological characteristics of the bile.
3. Bacteriology.
4. Permeability of the cystic duct.
5. Morphology of the gallbladder, anatomical relations, adhesions.
6. Presence or absence of gallstones.

The trouble to which the sum of all this puts the patient is relatively slight when compared to the great benefits which may be derived from establishing a combined diagnosis.

This modest contribution to the non-surgical diagnostic exploration of the gallbladder I offer in the hope that it may merit the compliment of approval and adoption in practice.

PLEURISY IN INFANTS AND CHILDREN*

RADIOLOGICALLY DEMONSTRATED

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NEW YORK

Acute Pleurisy

DRY OR FIBRINOUS PLEURISY

THE pleurae are not roentgenologically visible in their normal condition and relationship to the other parts of the chest. With the deposition of fibrin, however, even in thin layers a shadow outlining the affected part of the pleura is cast. This is seen as a fine hairline density closely adjacent to the lateral thoracic wall or in the regions of the interlobar fissures. It may be encountered early in a pneumonic process with which pleurisy is associated or later when it is residual to an effusion, serous or purulent. Such hairline shadows are frequently seen in children who have undergone tuberculous pulmonary infection; the pleural thickening overlies a primary focus, a diseased lymph node or a site formerly epituberculous. When part of or the entire surface of the pleura is affected there is a faint homogeneous veiling of the lung over the affected part.

FREE EFFUSION IN THE PLEURAE

SEROUS OR NON-PURULENT PLEURISY

The initial roentgenological evidence of free serous effusion always manifests itself at the most dependent portions of the chest, in the costophrenic sinuses of the bases. (Fig. 1.) The normally sharp outlines of the diaphragm and costal wall become obscured by a homogeneous shadow which is faint or dense, depending on the amount and depth of the fluid present. The effusion may remain limited. It may increase in amount and extend upwards in the pleural cavity and manifest the extension roentgenologically by an increasing height, width, and density of shadow. From the highest point of the effusion, which lies laterally in the axilla, the shadow slopes downwards to its most medial point on the diaphragm. In this way is formed the appearance of a triangle whose hypoteneuse faces the mediastinum with a more or less convex border. This is the result of:

1. The gravitation of the fluid to the most dependent parts (the posterior and postero-lateral parts.

2. The elastic tension of the lung which pulls on the surface of the fluid causing the most elevation in the axilla where the tension is greatest (Wessler and Jaches).

3. The fact that the inferior lobe is largely posterior and is first to suffer compression towards the mediastinum, thus permitting the largest fluid accumulation in the posterior and postero-lateral portions.

The demarcation of the fluid accumulation is sharply defined in the small and moderate sized effusions. As the amount of fluid increases, the compression and atelectasis of the adjacent margin of the lung increase; a pulmonary shadow is therefore cast which creates a haziness of the otherwise sharp line of the fluid margin. The medial line of fluid effusion not only becomes less sharply defined with increasing quantity of fluid, but tends to become less convex and more horizontal in position. Characteristic of all large effusions is a displacement of the heart and superior mediastinum towards the opposite side, with a depression of the diaphragm of the same side. Shadows cast by fluid are homogenous and dense, obscuring all lung markings. The opacity is greater even than that of pneumonic infiltration and approximates that of caseation.

Associated with the accumulation of large amounts of fluid in the pleural cavity is a widening of the interspaces,

* From the Department of Pediatrics (Dr. Schick) and the Department of Radiology (Dr. Jaches) the Mount Sinai Hospital, New York This article will be part of a chapter in the author's forthcoming book on "The Chest in Children, Roentgenologically Considered" to be published by Paul B. Hoeber, Inc., N. Y., 1930. Submitted for publication February 27, 1930.

and a fullness and immobility of the affected side, observed fluoroscopically, which is characteristic for such effusions contain only a small amount of free fluid. It appears as a band- or ribbon-shaped shadow adjacent to the thoracic wall, due

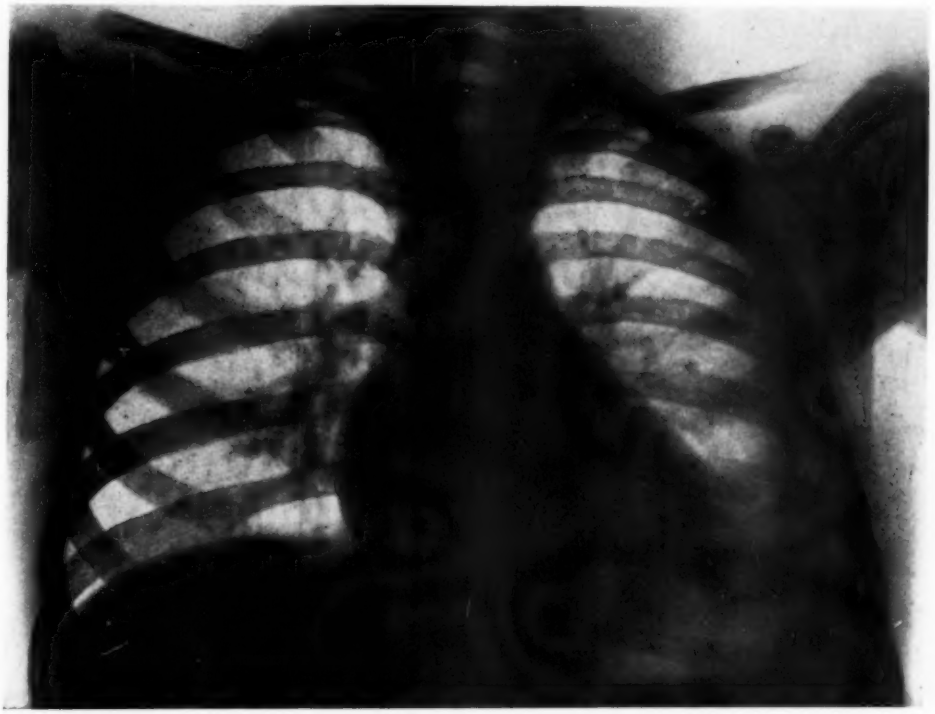

Fig. 1. Free pleural effusion of moderate extent at left base.

in children. In the early stages of effusion the reverse may be true; one may see a narrowing! of the interspaces, which together with a relatively narrowed and immobile chest suggests there is a reflex attempt to modify or arrest the pain of pleural involvement.

PURULENT PLEURISY OR EMPYEMA

Empyema may arise in three ways:

1. From a serous effusion which has become purulent.
2. From the rupture of an abscess into the pleural cavity.
3. From a fibrinoplastic exudate arising in pneumonias.

In the first two instances the X-ray appearance does not differ from that of a serous effusion; purulent effusions cannot be differentiated roentgenologically from serous effusions. In the third instance, there is a shaggy fibrinoplastic exudate on the visceral pleura the interstices of which to the separation of the lung from the chest wall by the fibrinoplastic exudate. This is an early sign of empyema and may antedate the appearance of suggestive physical signs and the presence of free pus on exploration. The shadow may at first be relatively narrow and uniform in width; later it widens and becomes broadest at its base as its fluid content increases and gravitates to the base. The rest of the lung field is clouded if the exudate encases the entire lung or one side of the lung. The peripheral band-like shadow is often seen even in those instances of exudation over the entire lung surface because the rays traverse the entire thickness of the exudate on the edge of the lung, thus causing a summation of the shadow on the posterior axillary, axillary and anterior axillary surfaces. The fibrinoplastic exudate may lie over the upper lobes alone, the lower alone or both. It may be seen over the lower lobes when the

pneumonia affects the upper lung, or over the site of the pneumonic infiltration in which case it is extremely dense on account of intensification by the infiltration. As the amount of free pus increases it approximates more and more the appearance of a free serous or purulent effusion. The demarcation of the diaphragm disappears so that the liver opacity blends with that of the exudate, a sign which during lower lobar pneumonia may be considered as characteristic of empyema (Wessler and Jaches). In the so-called pleuropneumonia there is present early in the course of the disease an extensive, thick, shaggy, fibrinoplastic exudate over the affected lung which appears roentgenologically as a very dense and very broad peripheral band-like shadow with an irregular medial margin. The clinical course is prostrating and early empyema or exitus occurs.

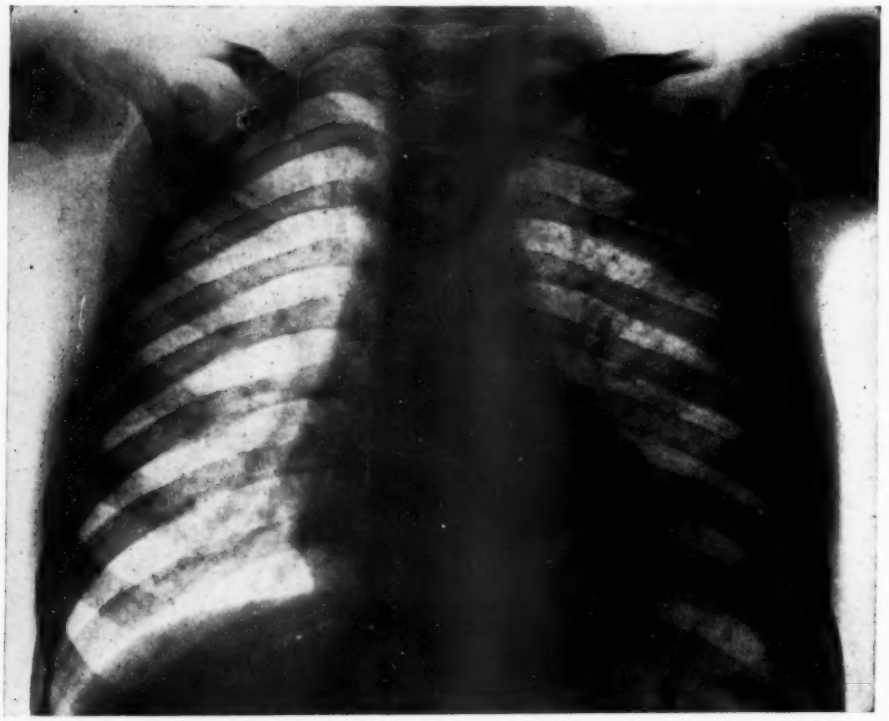

Fig. 2. Encapsulated effusion. Generalized haziness of entire left lung due to early acute pleural affection.

ENCAPSULATION OF EFFUSION

Infection plays the decisive rôle in the determination of encapsulation. The plastic exudate of inflammatory processes leads to the agglutination of opposing surfaces to form sacculations in contradistinction to the transudates of cardiac diseases (Wessler and Jaches).

Encapsulation of purulent fluid is common in the earliest years of life. The effusion may be superficial in the general pleural cavity in contact with the costal wall, or deep (concealed) and not in immediate contact with the costal wall. The apical, basal, and axillary encapsulations are superficial; the interlobar, mesial, mediastinal and infrapulmonary encapsulations are deep. Physical signs of the presence of superficial ones are easy to elicit while those of the concealed encapsulations may defy recognition unless one resorts to roentgenography.

SUPERFICIAL ENCAPSULATED EFFUSIONS

Encapsulated effusions which are superficial may occasionally present the appearance of free fluid collections with the tapering fluid borders. The usual appearance, however, is that of homogeneous, dense, more

or less globular or ovoid shadows the shapes of which are modified by the contiguous structures and adhesions. When a effusion but the presence of râles due to resolving infiltration and unretracted lung confuses the issue so as to delay explora-

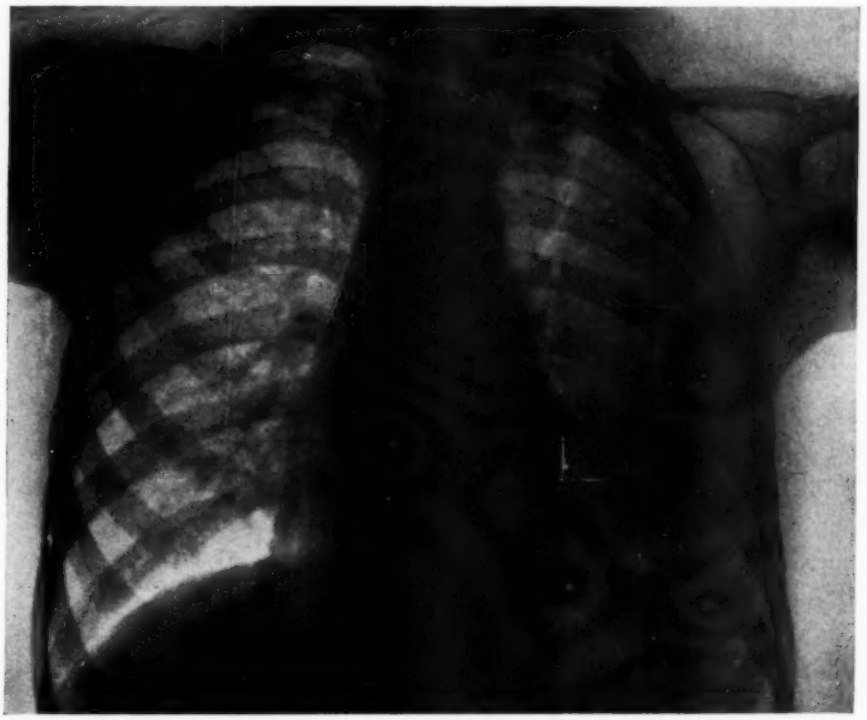

Fig. 3. One week later, there is an encapsulated effusion in the left axilla. Medical boundary is sharply defined and medially convex.

free margin is present, it projects into the lung field with a sharply defined, usually convex or globular, outline. Diagnostic for encapsulation is the appearance of a globular, dense shadow projecting from a peripheral or central attachment into the lung field. Occasionally an encapsulated effusion is so large as to occupy almost the entire lung area so that its shadow is continuous with that of the mediastinum and only a small part of clear lung is seen above or below; the upper or lower level is convex upwardly or downwardly, and in the first instance it would be differentiated from a free effusion by the upward convexity. (See Figs. 2 and 3.)

The most frequent site for fluid encapsulation in infants and children is in the axillary region, either at the base or apex. Physical signs may be confusing, particularly in the presence of coexisting pneumonia. The flat note is suggestive of tion. The localization of the process is important to the surgeon; it must be borne in mind that variations in technique may so alter the shadows as to cause them to appear larger or smaller, or higher or lower, than they actually are. Fluoroscopy, combined with the lateral and the postero-anterior film examination, should be utilized for exact localization before using the exploratory needle. There may be only one sacculation, or several. The outline of the shadow is sometimes suggestive of multiple locules because of a notching, but more often notching is not present or not to be distinguished. The importance of recognition of multiple encapsulations is paramount to the surgeon who without this knowledge may empty but one loculus leaving others untouched. With spreading infection the adjacent pleurae are stimulated to fibrinoplastic exudation which may be observed roent-

genologically as a band shaped shadow projecting downwards or even upwards from the limit of the encapsulated effusion.

MESIAL EFFUSION

There is a type of encapsulated effusion which Wessler and Jaches call mesial because it occurs in that portion of the pleural cavity which borders on the heart. It appears as a dense, homogeneous widening of the mediastinum which in the absence of antecedent clinical history might be mistaken for massive adenopathy. Mesial effusion may be primary but is usually secondary to empyema in other parts of the chest.

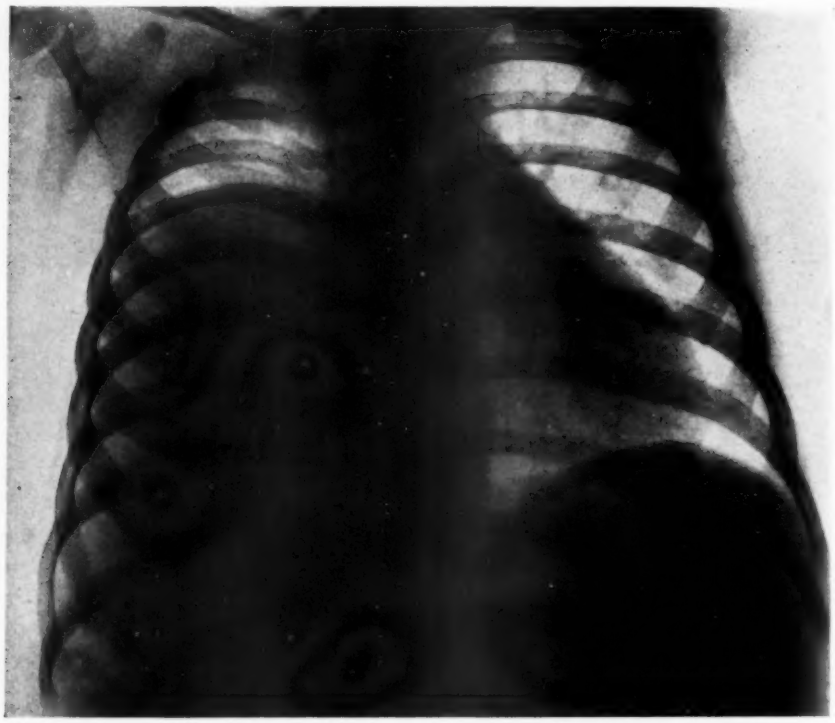

Fig. 4. Extensive infrapulmonary (diaphragmatic effusion) on right side. The upper border is convex superiorly. There is a slight pleural involvement at apex. Operation.

In this way it comes about that new loculi form and that adjacent ones may contain exudates in varying stages of thickness. In the presence of air, just as in the free effusion, the fluid level is easily seen when the patient is in the erect posture.

CONCEALED OR DEEP EFFUSIONS

The clinical diagnosis of effusions which are hidden or deep and have no point of contact with the costal wall which would simplify the elicitation of physical signs, must rest in greatest part on the roentgen findings for localization as well as recognition. These effusions by virtue of their position in the interlobar fissures, mediastinum, or on the diaphragm inferior to the lung are usually encapsulated. They may be serous or purulent. Roentgenography and roentgenoscopy in the lateral and oblique positions as well as in the anterior and posterior projection are indispensable in these instances.

DIAPHRAGMATIC OR INFRAPULMONARY EFFUSION

Effusions may collect between the pleurae of the lung and the diaphragm and remain localized in this infrapulmonary region. They may also communicate with mediastinal effusions, or parietal ones. When localized, this type of effusion appears as a dense, homogeneous shadow continuous with the heart medially and with the liver when the effusion occurs on the right side. The upper border shows a curve

with the convexity upward. This upward convexity is characteristic of such encapsulation. The effusion may be small or so large as to extend upward to occupy a large part of the chest. (Fig. 4.)

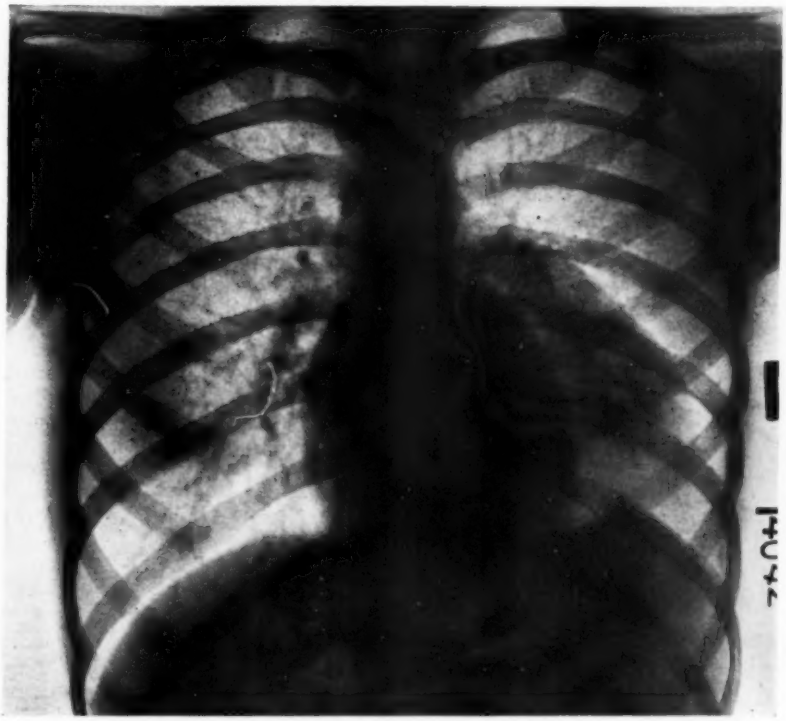

Fig. 5. Mediastinal effusion. Large encapsulated effusion encasing left heart. There is some pleural thickening at left base.

Such effusions cannot be differentiated roentgenologically from subphrenic abscesses. It is only on operative exploration that the exact relationship to the diaphragm can be determined.

MEDIASTINAL EFFUSION

By mediastinal effusion is meant a collection of fluid between the mediastinal and pulmonary layers of the pleurae, without a communication with the general pleural cavity. Adhesions necessarily exist if the effusion is limited to this location. The effusion is either anterior or posterior, or to the left or right of imaginary planes at the roots of the lungs. It is usually unilateral. The localization is accomplished by means of fluoroscopy or roentgenography in the dorsoventral, ventrodorsal, lateral, and oblique positions, bearing in mind that the more distant from the screen an object lies the larger will it appear and the greater will be its arc of rotation. As an illustration, an encapsulation on the left side posteriorly will appear larger in the dorsoventral than in the ventrodorsal position. When in the lateral position the left side is closest to the screen, the area of encapsulation will appear smaller than when the right side is adjacent; at the same time its anterior or posterior position may be determined. On rotation of the patient from side to side, the movement of the sacculation will describe a larger arc when he faces the examiner than when the patient faces the tube. The effusion will vary in roentgenological appearance according to its anterior or posterior position. When it is posterior it is usually band-shaped, vertical and parallel to the spine (Savvy, Assman). Its breadth will be modified directly by the amount of fluid present. In the anterior position it takes on a triangular outline with the hypotenuse straight or convex,

facing laterally, the base on the diaphragm, and the other side adjacent to the spine. The shadow is dense and homogeneous.

Fig. 6. Lateral view showing multiple ureas of lung suppuration with which are associated in interlobar fissures outlining middle lobe.

When there is an effusion in the region of the sinus, where reflection of the mediastinal pleura to the costal wall takes place, together with an effusion in the mediastinum, a costomediastinal effusion is seen (Herrenheiser). Such an effusion posteriorly creates the appearance of an anterior mediastinal effusion, that is, a triangular shadow whose hypoteneuses face laterally. Effusions in the posterior mediastinal space are frequently costomediastinal. (Fig. 5.)

When the effusion is marked the shadow may extend beyond the limits of the cardiac density; when moderate or small it lies concealed behind it, particularly on the left side. It is in this way that a double contour of the heart is formed. The summation of both the fluid and the heart densities causes an increased opacity in the region of the effusion. There are other conditions which produce an appearance of double contour of the heart from which an effusion must be differentiated. They are: collapse of the lower lobe, retrocardiac pneumonia, bronchiectasis, Pott's abscess, and adenitis situated posterior to the heart.

Pneumonias, like effusions, are homogeneously dense but their limitations are not as a rule so sharply defined unless there is an interlobar demarcation which in this location would not occur. Pneumonias in regions which come into differential consideration do not appear band-shaped; and, if triangular, the border is not so straight, sharply defined or convex as in the effusions.

Collapse of the lower lobe is roentgenologically similar to an effusion of the anterior mediastinum or to a posterior effusion which is costomediastinal. Here the clinical course and history must aid the differentiation. With collapse, there is always a compensatory emphysema of the upper lobe.

Bronchiectasis may be located in the lower lobes posteriorly and medially. With

it there may be collapse of the diseased lobe, the *x*-ray appearance of which resembles mediastinal or costomediastinal

Massive swelling of lymph nodes behind the heart, the bifurcation nodes, may be pronounced enough to create a more or less

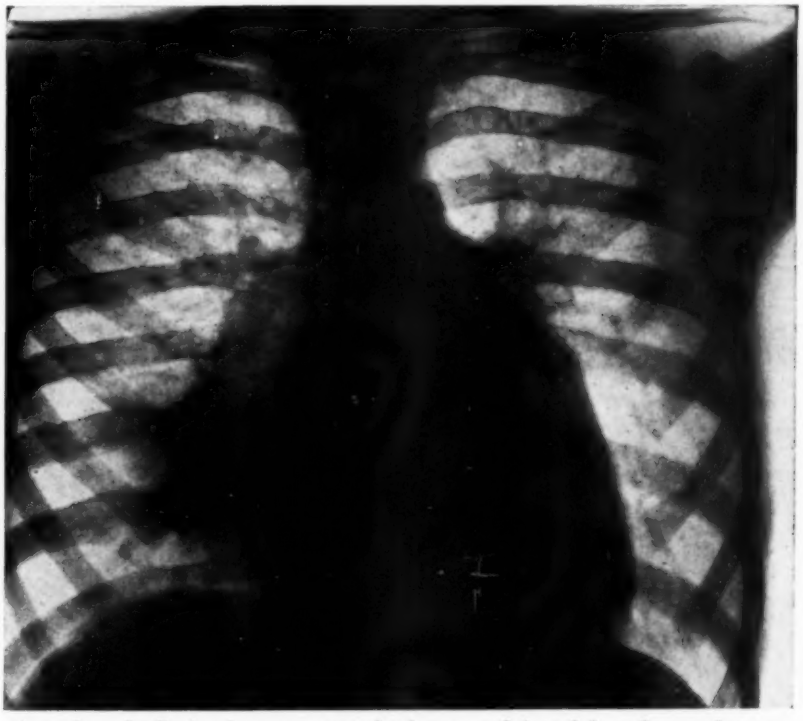

Fig. 7. Communicating pleural effusion between costal pleura and interlobar fissure between right upper and middle lobes.

effusions. An irregular, honey-comb-like shadow or multiple dilatations may be roentgenologically so evident as to immediately indicate the nature of the process. It is sometimes necessary, however, to introduce some contrast-producing substances, such as iodized oil, to outline the dilatations. The clinical history and signs of bronchiectasis, either in the presence or absence of characteristic dilatations, aid the differentiation from effusions of the mediastinum.

In Pott's disease, the abscess may be unilateral and its lower part located in or adjacent to the mediastinum, so that the *x*-ray appearance may simulate mediastinal effusion. The vertebral column must be examined for a focus or a suggestive narrowing of the intervertebral discs. Pott's abscesses are usually bilateral, not necessarily symmetrically so, more or less elliptical, and associated with manifest disease of the vertebrae.

triangular dense shadow whose lateral margins, however, are usually rounded and perhaps notched, suggesting lymphadenopathy. The swelling is usually bilateral.

INTERLOBAR PLEURISY

For the understanding of pleural effusion in the interlobar fissures a visualization of the anatomy of the interlobar fissures is necessary. The lung is as a rule divided by interlobar fissures into an upper, a middle and a lower lobe on the right side and an upper and a lower one on the left. There is, then, a large interlobar fissure on either side separating the upper from the lower lobes and in addition a small one on the right side between the upper and middle lobes. The middle lobe is bounded inferiorly by the lower part of the large fissure. While this is the usual division the presence of aberrant or incompletely separated lobes is not uncommon.

Recently the azygos lobe has been

described roentgenologically and confirmed at autopsy by Wessler and Jaches, Bendick and Wessler, and Stoloff. It is more commonly outlined in the roentgenograms of children than in adults. This lobe is caused by a persistence of the fetal position of the azygos vein which lies lateral to the spine. In its passage from the posterior chest wall to its point of entrance into the superior vena cava the azygos vein traverses the tissue of the right upper lobe. Accompanying it is a reflection of the parietal pleura which occupies the azygos fissure between the azygos lobe and the rest of the right upper lobe. The fissure is outlined by a faint linear shadow, coursing from the apex, either at its midpoint or more medially or laterally, downwards with an outward convexity which varies in depth, to the level of the second costal cartilage where it terminates in a dense button-like, spindle- or comma-shaped shadow about the size of a pea which represents the confluence of the azygos vein with the superior vena cava. The azygos lobe is subject to the same pathological processes as the other lobes.

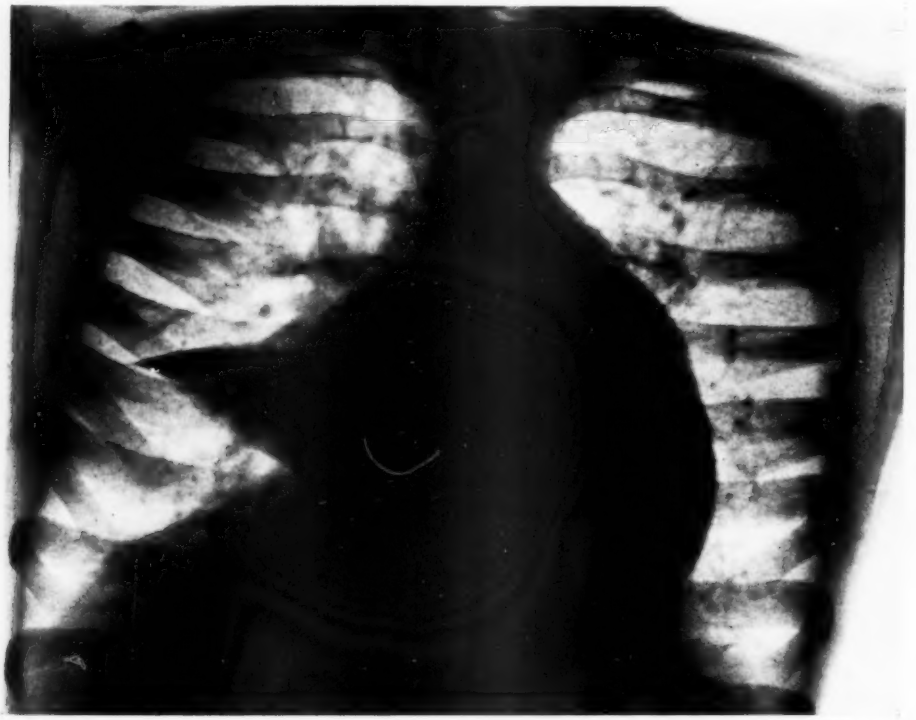

Fig. 8. Homogeneous shadow near right cardiac margin at base, the nature of which suggests infiltration. Left ventricle is enlarged.

TOPOGRAPHY OF THE FISSURES

Left Interlobar Fissure. This consists of a line beginning 6 to 8 cm. below the apex at about the level of the third dorsal vertebra, extending from the posterior margin of the medial surface of the lung, backward and slightly upward to the posterior surface, then arching slightly over the posterior convexity and downward, it crosses the fourth interspace in the mid-axillary line, and extends to the level of the sixth costal cartilage, cutting the lung above the cardiac incisure. Thus it makes of the inferior part of the lower lobe what was called by Luschka a tongue-shaped process of lung, which is now known as the lingula. This represents the external markings of the left or great interlobar fissure; the diaphragmatic and mediastinal markings were not portrayed until Fleischner adequately

described them. If the line described in the foregoing is continued dorsally and medially on the diaphragmatic surface liquely, posteriorly and medially toward the lower part of the hilum. The lung tissue lying anteriorly and medially (the

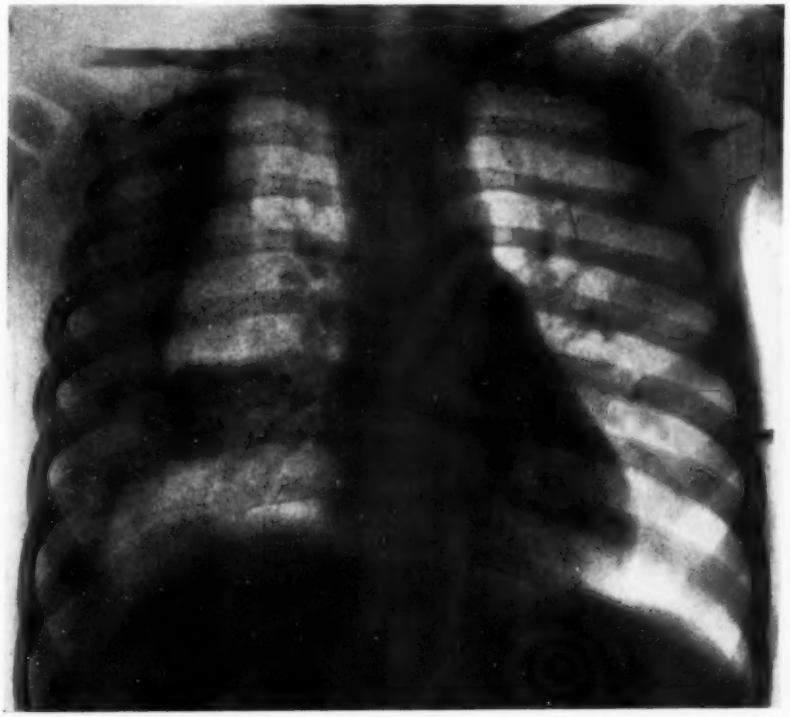

Fig. 9. Roentgenogram in lordotic position reveals effusion in lower part of large interlobar fissure adjacent to mediastinum, evidenced by triangular shadow protruding laterally.

toward the lower medial margin of the lung below the hilum, then extended, slightly dorsally, upward to the hilum, and from above it steeply to the level of the third dorsal vertebra, the diaphragmatic and mediastinal markings are now completed. Because of the predominantly left-sided position of the heart, only a narrow part of the upper lobe has a diaphragmatic surface.

The right side differs from the left as follows: Right Interlobar Fissure: A line starting at the level of the third dorsal vertebra and extends posteriorly to the posterior convexity of the lung, over which it then arches with a convexity less marked than on the left side, and begins its descent toward the axilla on a less steep incline. The diaphragmatic surface is reached in the anterior or mid-axillary lines, or between the two; from there it takes its course on the diaphragm ob-

middle lobe) thus comprises one-fourth of the diaphragmatic surface. The mediastinal course is similar to that of the left side. The fissure between the upper and middle lobes of the right side is represented by a line practically horizontal at the level of the fourth rib, extending laterally to the great fissure.

If the great fissures are projected on a flat surface, a propeller-like figure (Dietlen) is produced. They may be visualized as oval surfaces which are not plane, lying at an angle of 45° with the bases of the lungs and which have been twisted on themselves with the hilum as a fulcrum, so that the upper half faces forward and slightly laterally and the lower half faces forward and somewhat medially. The medial boundaries of the great fissures are less oblique than the lateral ones. The small fissure on the right side, called dome-shaped by Fleischner, which is in-

clined laterally more than anteriorly, has an upward convexity which is more marked dorsoventrally than mediolaterally. Since the fissures vary in depth the lobes may be connected by only a pleural bridge or a small pulmonary pedicle or they may be practically continuous with each other save for a superficial fissure. The pleurae are best thought of as sacs which are so invaginated by the lung that the interlobar as well as the costal, diaphragmatic and mediastinal surfaces, except in the root area for entrance of the vessels and bronchi, are completely covered by a continuous serous membrane which is always in close apposition with another pleural surface.

ROENTGEN DIAGNOSIS

Owing to the oblique position of the great interlobar fissure the upper lobe is really in a sense anterior, as is also the middle lobe; the lower lobes are posterior. If there is a small effusion or a thickening of the pleurae in the large slit and the *x*-ray tube is focussed in the customary position upon the upper dorsal vertebrae, the rays may penetrate through it so that there will be no shadow or at best only a very faint one, for the fissure is narrow and there is an attenuation or subtraction of shadow density by the adjacent aerated lung. The impression on the film or screen will be faint, hazy and not definitely circumscribed. With increasing amounts of effusion or thickening the density increases but it is usually not sharply outlined. Such processes are most commonly located medially and contiguous to the mediastinum, for an interlobar mediastinal pleurisy is frequently present. The density extends from the root of the lung laterally. The shadow is homogeneous and infiltrative processes are suspected.

If a lateral exposure be made the true nature of the pathology becomes apparent. Great penetration must be used in order to differentiate it from the cardiac density. Dependent upon its location (upper, middle or lower part of the fissure) its length will vary and the amount of exudation or fibrous thickening will determine its thickness. If the involvement be in the upper part, it is seen in the lateral examination as linear or as a band-shaped shadow; or, if there is effusion, it appears as an oval, globular, or elliptical shadow, dependent on the amount of fluid and separation of the pleural surfaces from each other (Fig. 6). This is also true in the lower parts of the fissures. When there is little or no adhesion of the apposing surfaces the fluid content gravitates to the diaphragm and a more or less triangular shadow is produced which rests on the diaphragm and courses obliquely upward and backward.

In the posteroranterior position the exact nature of the involvement may come to light if the fissure is so placed that its greatest length or depth will be horizontal to and traversed by the central rays of the tube. In this manner a summation of shadows is effected and a definite sharply circumscribed shadow is cast. This position may be attained in one of two ways: (1) The lordotic position, first utilized by Fleischner, then by Wimberger, Rach, Stoloff, in which the patient is made to assume extreme lordosis by protrusion of the abdomen while the shoulders are held back; (2) elevation of the tube to a high point, with downward tilting, while the film is relatively low in position (Stoloff). In infants the first technic must be used by holding the patient in lordosis. Older children easily imitate the position after it is demonstrated. The first is the technic of choice.

In roentgenograms made in either manner a shadow appears which is band-like, globular, oval or triangular, and which is sharply circumscribed above and below, standing out clearly in the lung field, and occurring in any part of the fissure. It is usually medial. When there is an associated involvement of the mediastinal pleurae, as is quite frequent, a triangular pennant-like density projects from the

cardiac opacity laterally into the lung field. This is characteristic of a mediastinal-interlobar pleuritis (Fleischner), although it occasionally occurs in the absence of associated mediastinal pleural disease (Figs. 7 and 8). Small effusions cannot be differentiated from thickenings (Fig. 6). As the fluid accumulation increases its nature becomes recognizable, for thickenings do not attain such size nor do they have configurations such as globules or ovals. When the fissure between the middle and the upper lobes is attacked this involvement is easily recognized in the usual dorsoventral position, for the ray in passing through its entire depth the fissure being more or less horizontal, brings about a piling up of the shadow. The roentgenographic image appears as a hairline or a band if thickening or slight effusion is present, or as an ellipse if a larger effusion is contained. Since the fissure is dome-shaped, sometimes more accentuated than at other times, it may have, in a sense, two levels. For this reason two parallel hairline shadows are occasionally seen (Schoenfeld). When mediastinal pleuritis is associated with middle-fissure disease a sudden widening may extend into the cardia, producing the appearance of mediastinal interlobar pleurisy as already described, but the latter is seen in the large fissures only in lordosis.

Several pleural surfaces or combinations of them may be simultaneously affected so that communicating shadows are distributed through a lung field. Thus, there may be a well-defined shadow of effusion in the uppermost part of the fissure separating the upper and lower lobes, continuous with a band-like shadow over the lung indicating free effusion (Fig. 9). On examination in the lordotic position, the lung field may reveal an additional effusion in the lower parts of the great interlobar fissure.

Interlobar pleurisy in children is not uncommon. The most frequent cause is tuberculosis, arising in one of the following ways: the primary focus is adjacent to the interlobar pleura, or a primary or secondary infiltration lies contiguous to it, or there is a pleural reaction caused by the proximity of the mediastinal limits of the fissures to the diseased regional lymphnodes. At times there are communicating nodes which are actually present within the limits of the fissures, exerting a direct effect on the pleura.

Other causes of interlobar pleurisy are non-tuberculous pneumonias and cardiac decompensation. These are far less frequent.

Chronic Disease of the Pleurae

After the resolution of a pneumonic infiltration, a fine hairline or narrow band-like shadow may be seen adjacent to the lateral costal wall, caused by a fibrosis, the sequel to an infiltration. This may gradually disappear or persist for a long time. Such thickenings are frequently seen in the interlobar fissures as well as on the pleurae of the mediastinum. They may follow healed empyemas, tuberculous effusions and dry pleurisies. Where the thickening affects the whole or a part of only one surface, a shadow appears as a homogeneous veiling overlying the involved part. If the lateral parts are free of pleural disease, the customary band-like axillary thickening is not present. Fibrous adhesions between the pleurae and the diaphragm or mediastinum frequently follow in the wake of pulmonary inflammation. Their presence may not be seen but it is suggested from the impairment of movement of the diaphragm or the mediastinum, when the patient is studied fluoroscopically. They are more frequent in older children than in infants. The larger adhesions cast string-like, band-like shadows, or tiny pyramidal projections on the attached part.

Occasionally there is a persistent chronic massive thickening of the pleurae which is seen as a dense homogeneous shadow obliterating the whole or a part of the lung field, and by fibrous adhesions contracting the entire thoracic part. Atelec-

tasis of the underlying lung may be present. The ultimate appearance may resemble that of a massive atelectasis of the lung, with mediastinal displacement and diaphragmatic elevation towards the affected side. The differentiation will rest upon the clinical history and course, with particular consideration of the history of operation or foreign body aspiration.

There are two shadow-casting conditions in infancy and childhood which must be eliminated as confusing factors likely to lead to an erroneous diagnosis of pleural thickening or exudation. The first is the position of the scapula, the inner margin of which may overlap the periphery of the lung, casting a linear shadow parallel to the outer boundary of the thorax. Demonstration of its continuity with the rest of the scapula will readily differentiate this shadow from a pleural thickening. The second condition is seen in some infants where the ribs at the sternal junctions undergo rachitic widening of the epiphyses, at times so marked that the shadows are continuous one with the other creating an appearance of a ribbon-shaped shadow adjacent to the lateral thoracic wall, simulating pleural thickening or exudation. Close examination, however, will show evidence of rickets, and the clinical history and signs will definitely eliminate pleural disease. In addition a pleural thickening as wide as the shadow cast by a rachitic rosary is usually denser, sharper, more smoothly defined and does not show the multiple medial convexities which outline the epiphyses.

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EDITORIALS

ABORTION AND CONTRACEPTION

FOR INDICATIONS OTHER THAN PURELY MEDICAL

WHEN J. Whitridge Williams, in July 1928, addressed the University of Washington on Indications for Therapeutic Sterilization in Obstetrics,[1] he invited the criticism of his colleagues. In clear straightforward fashion, many of his cases were presented, "so that the justifiability of the course pursued can be criticized." Up to now no one, to our knowledge, has reviewed his opinions, either to approve or to take issue with them.

In a group of 118 women sterilized at his clinic, there were 15 sterilized for mental or psychiatric conditions, and 4 for social indications. Although he has rejected many cases sent to him, because they do violence to his conscience, he is clear on these. In the rest of the group, and here he believes that few will take serious exception, there are 45 cases sterilized by hysterectomy, or hysterotomy with exsection of the proximal end of the tube, *prior to viability of the child*. This gives him no concern, but he is not at all sure that his procedure in the first 19 cases will meet with general approval. Yet I am disturbed, because, in a specialized obstetrical experience covering many years in two large hospitals, I have not found it necessary to abort or sterilize anyone.

He discussed contraception as well, and,

like him, I find abortion, sterilization and contraception so intimately related, as to make individual treatment from a medical point of view difficult. Abortion is but a by-product of sterilization in many of his cases, and, at best, sterilization is but contraceptive treatment made reasonably certain.

Reviewing his cases briefly, we find 4 cases of pronounced feeblemindedness, 4 cases of dementia precox, 2 cases of frank psychosis, 1 case of chorea and repeated puerperal insanity, and 1 case of postencephalic depression. Seven of these patients were sterilized during pregnancy, prior to viability of the child.

As to the four social indications. One girl of eighteen with a contracted pelvis, syphilis, tuberculosis and general worthlessness was sterilized at cesarean section in her first pregnancy. Another with 2 microcephalic children had abdominal hysterotomy and sterilization in her third month. A girl of twenty, mental age twelve, was sterilized at her second cesarean section; while the fourth, age twenty-seven who had undergone two cesarean sections and four spontaneous deliveries, was sterilized because she was losing ground physically, had a worthless husband, and could not keep a position if she were constantly pregnant.

Sterilization is widely practiced, with and without much thought on the part of the operator, but often because he is influenced by the desire of the patient or by the pitiful story she tells. In a recent survey of 1805 cases of cesarean section made by the Brooklyn Gynecological Society,[2] sterilization was done in 59 out of 834 cases of contracted pelvis, and in but 16 out of 130 cases of repeated cesarean sections.

Abortion may or may not be the material corollary of contraceptive failure, but apparently it often is. Contraceptive advice is widely given, when, in the physician's opinion, pregnancy would jeopardize life, or even health, through the operation of social or economic factors over which the physician or the patient have no control. I do not contend that the physician should be prepared to induce abortion, if failure follows his instructions. Not at all. It may be though that there is no middle ground; one may follow the other. Many, however, give birth control information for reasons for which they would shrink from inducing abortion.

But even medical indications are not universally accepted and wide divergence of views exist. We have no one mind upon this important subject. There are 29 birth control clinics in the United States. Let us look at the report of one of them, one which we would expect to be the most conservative. In the First Report of the Bureau of Contraceptive Advice in Baltimore,[3] J. Whitridge Williams analyzed 168 histories of those who had been given advice, and divided them into 4 groups.

In the first group of 70, there were 38 cases in which the indications were tuberculosis, kidney and organic heart disease. There were 14 nervous disorders listed as psychoneurosis, morons, dementia praecox, and 1 patient whose husband had a mental affection. The remaining cases comprised syphilis, thyroid disease, epilepsy in the wife or husband, recent operations, fracture of pelvis, encephalitis in the husband, spina bifida, chronic asthma, breast lesion, acute gonorrhoea, and hypertension with difficult labor. A wide and varied assortment of "those presenting definite medical indications." Williams says that in nearly every instance, the indication for advice seemed thoroughly sound.

In the second group of 23, advice was given to those who complained of too frequent pregnancies, with complications listed as undernourished (2), anemia (4), general debility (3), asthenia (3), 15 miscarriages (1), running down (2), husband drunken (1), syphilis (1) and debility (6). Here Williams states that advice was justifiable both from the medical and humanitarian point of view.

The third group Williams admits is

more debatable. Sixty women had an excessive number of pregnancies within a comparatively short space of time. Here the income of the husband was held to be an important factor.

In the fourth group, the historical data were not sufficient for judgment, but Williams feels that he would have agreed had he seen the patients.

That contraceptive advice and treatment may be given as a matter of right, many will deny; but that it is common practice no one will dispute. That medical indications are far flung, this report bears solemn witness. We give advice for run-down conditions and general debility. If general housework were included, no one need have a baby.

There are, however, certain vague but widely accepted indications for abortion. It is easy enough to enumerate medical conditions, but I am sure that clinically the patient is more than a case record. Even those who would agree upon fixed indications, would probably disagree in the management of their cases. Hard and fast lines may not be drawn.

Once we felt that abortion was lawful only if life itself were threatened by continuation of pregnancy, but now serious or even possible damage to health constitutes a valid reason for interference. The child itself apparently is not considered.

There is general agreement that severe kidney lesions call for active intervention. If albuminuric retinitis is a positive indication, hypertension and edema certainly are not. There is much evidence to show that continued pregnancy results in further kidney damage, yet conscientious effort should be made to carry the child to viability.

The case for tuberculosis is not so convincing. In active cases, the risk certainly increases. Parturition, it is said, fans latent lesions to a flame, but there is absolutely no proof that early interference would prevent exacerbations, or that abortion may not be as harmful in its effects as labor itself. In arrested cases, I believe it does more harm than good. The chief argument against pregnancy is that it is apt to bring about forgetfulness of the lesion and neglect of treatment. But there is no excuse for that.

In heart disease, mitral stenosis or otherwise, early abortion is based upon pure speculation. Broken compensation is not due to the pregnancy, unless the uterus is of sufficient size to cause circulatory embarassment, a distress due to mechanical factors. Viability should always be awaited and cesarean section considered. Recent advance in the technique of local anesthesia, and the increasing safety of spinal, strengthen this position.

With all this we should be deeply concerned, for there is a changing point of view in the medical profession. Social, economic and eugenic reasons move us deeply. The ethical standards of the public are lower than ever, and the physician has become less and less able to withstand the pressure brought to bear upon him. Medical indications are apt to be loosely accepted at their face value, and a multitude of other reasons find steadily increasing favor with us. Times have changed, and we with them.

Modern life steadily diminishes women's capacity for childbearing. Husbands meet increasing economic stress less willingly. A safer technique and emolument has swelled the ranks of the criminal abortionists. Women are aware of our slackened conscience. Their friends have found honest doctors more sympathetic, more acquiescent, not so deaf as they once were. A little emphasis on this or that point, and her cause is as just as the next one, a vicious circle.

Common sense and thinking for ourselves has brushed aside old religious deterrents. Common contraceptive knowledge has shaken and weakened our moral fibre. Birth control propaganda grows more ardent. We are advised to space our children, to leave little or nothing to nature. "The patient may be advised to make the insertion of the pessary a part

of her evening toilet if desired, so as to be always prepared . . . [it] made a part of the daily routine of undressing." Dilatation, rupture or snipping the hymen to fit a pessary is recommended. "If this procedure were adopted by all young women before marriage, it would save considerable embarassment and sometimes much pain."[4] "It was the last straw," says another, who possibly inherited his contraceptive beliefs. "I have a very distinct memory, dating from my seventh year, of my discovery of a paper covered book on contraception, carefully hidden away in the top drawer of my mother's wardrobe, and an irreverent member of the family once referred to me as an "accident." So I can only suppose that some attempts at contraception had been made, though of their nature, duration and regularity, I have no exact knowledge."[5] Nothing is sacred. Not even our mothers.

Perhaps we go too far. If adequate reasons for contraception include general debility, general malaise may be added. There was a time, however, when abdominal sterilization, and deliberate destruction of the fetus, not because its presence jeopardized life or even health, but because its eugenic outlook was poor, would be considered a crime akin to infanticide. Perhaps it is.

Fairbairn[6] believes that none other than purely medical considerations should be allowed to influence us. Once other than purely medical factors are allowed to count, no line can be drawn between therapeutic and criminal abortion. "Nothing is worse than the mental torture of illicit pregnancy, "he says. "Are we then justified in terminating these?"

Ethics and morals are not a religious matter. Men may decide upon a basis of morality, it is true, but our conscience is founded upon and guided by something deeper than that. We do not have to invoke divine revelation. Rather do we depend upon the unchanging law of good and evil which is binding upon all of us, and finds its expression in all sorts of principles with which we are constantly in contact. The physician is not the dispenser of life and death. He is not the arbiter of the universe. Individual cases may evoke his pity and wring his heart, but he should feel no call to redress all the wrongs and cure all the wrongs and cure all the ills of society. That would keep us very busy.

To the question, "Have we the right to interfere with a normal pregnancy?" My answer is "No."

Charles A. Gordon, M.D., F.A.C.S.

[The author has made out an excellent case against birth-control and the interference of a normal pregnancy. We will be glad to receive other comments on these subjects. Ed.]

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RADIOLOGICAL DETECTION OF ABDOMINAL ADHESIONS

We frequently hear it said that the x-ray "failed to show" abdominal adhesions. Pleural adhesions, thanks to the surrounding medium of air in the lungs or in the pleural cavity, can be shown very satisfactorily but abdominal adhesions are non-opaque to the x-ray.

The detection of intraabdominal adhesions is dependent upon certain circumstances, some of which are under the control of the radiologist: first, the ad-

hesions must fix or seriously limit the excursion of a normally movable, visualizable organ; or, second, in the case of the gastrointestinal tube the adhesions must interfere with the normal onward progress of the visualized contents of the viscus; or, third, pushing or traction by the protected hand or a wooden spoon under the fluoroscopic screen may move some structure so that adhesions may be reasonably inferred from a simultaneous movement of another structure to a demonstrable degree; or, fourth, pneumoperitoneum may be established and the adhesions actually seen.

It is well known that loose intestinal adhesions, even though involving numerous coils of small intestine, often result in no appreciable harm and cause no recognizable mechanical or functional disturbance. The adhesions which really cause trouble are those which by obstruction interfere with the motor mechanism or with the mobility of the bowel, or by traction cause pain. If the adhesions do none of these things (and many cases fall under this heading), then it will be practically impossible to visualize them by any x-ray manuever except artificial pneumoperitoneum, and this is a major procedure to which many surgeons prefer an exploratory laparotomy. When any such radiologically undemonstrable adhesions are found at operation, the surgeon is very apt to remark that the x-ray did not show them, and to leave an impression that the x-rays are often undependable.

One does not ordinarily see stars in daylight. The x-ray cannot be expected to do unreasonable things. It is a physical means which strictly follows physical laws. It is quite possible for adhesions to be present even between a normally movable organ and some fixed point without detection on x-ray examination, because at that particular moment the adhesions may not be producing any degree of obstruction. Such a patient examined again during one of his periodical abdominal attacks may show the typical x-ray signs of mechanical obstruction.

Therefore, when x-ray help is desired in the detection or localization of disturbing adhesions within the abdomen, the radiologist should be acquainted in detail with the problem and he should carry out his examination at such frequent intervals that he may discover even minor aberrations of motor behavior, and watch for a chance to examine in an acute attack. He must carefully manipulate under the screen during deep inspiration and deep expiration, and he must employ change of position and traction or pushing upon the scar or the abdominal wall. Further information may be deduced from a comparison of the films recorded at different times during the examination, noting the relative position of some definite loop of bowel under different circumstances.

In the face of a negative report following such carefully performed examination, adhesions may, of course, be present, but it is extremely doubtful if such adhesions will be helped by any surgical procedure.

James T. Case.

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"DUPUYTREN'S CONTRACTION"

GUILLAUME BARON DUPUYTREN was a character of varied facets. He was the first surgeon to do so many things; he was the most popular teacher of his day; he was honored as are few physicians; he had no friends; he left his wife and only loved his daughter; he was arrogant, sarcastic, envious of the success of others, had "a brutal lack of consideration for the patients entrusted to his care," and was dubbed by Lisfranc, "the brigand of the Hôtel Dieu."

He was born October 5, 1777 or 1778 at Pierre-Buffiere, a small town of Haute Vienne, near Limoges.

In 1789 a cavalry officer, with the permission of Guillaume's father, sent the boy to school in Paris. He attended classes for four years. Due to the effects of the Revolution the school closed. He was determined to complete his studies and at a great sacrifice, enduring true hardship, he finally reached his goal.

When about eighteen he was appointed prosector in anatomy in one of the schools established by Fourcroy.

In 1801 he was made head of his department with the title, *chef des travaux anatomiques*. Among his pupils were Laënnec and Cruveilhier.

In 1804 he successfully competed against Roux and others for the position of surgeon of the second class at the Hôtel Dieu. In time he was the surgeon-in-chief.

In 1812, after a brilliant rise, he was appointed to the chair of operative medicine as successor to Sabatier.

Dupuytren had but one hobby and passion—work. He arose daily at five and began his ward work at six. After morning rounds he gave his clinical lectures in the amphitheater, followed by operations, work in the out-patient division and post-mortem examinations. This finished the morning. During the afternoon he attended to his large consulting practice. In the evening he again made hospital rounds and frequently performed from one to three operations.

This routine year after year was too much for his body. One day while walking to the hospital he was taken with a slight stroke of apoplexy. He recovered and went on a tour of Italy, his first vacation. On his return he tried to carry on his old routine but his health failing he had to relinquish his place at the hospital.

Dupuytren was the first surgeon of his time and the founder of clinical surgery in France. He was the first to demonstrate the nature of yellow elastic and erectile tissue. He proved by animal experimentation that the spleen can be surgically removed with comparative safety. He taught that chronic enlargement of the testis is due to lues. He introduced greatly improved methods of treating fractures. We read he was the first to excise a carcinomatous cervix and the first to describe congenital dislocation of the hip. He changed the current treatment of urethral stricture, using flexible bougies. To this day his name is associated with idiopathic contraction of the palmar fascia, Dupuytren's contraction (1832). He wrote little. As a teacher he was famous.

He was a member of the Institute, a member of the Academy of Medicine and its president in 1824. In 1820 Louis XVIII conferred a baronetcy on him. He was surgeon to Louis XVIII and Charles X.

He died on February 8, 1835.

GUILLAUME DUPUYTREN

[1777-1835]

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

OLIVER WENDELL HOLMES*

PHYSICIAN, POET, AUTHOR

FREDERICK C. WARNSHUIS, M.D.

GRAND RAPIDS, MICH.

THERE is a common complaint against the biographies of men, that they are, with few exceptions, insufferably dry reading. The cause is simple in that, if a man has put the best of himself in his work, he has as a rule left little for another to tell. "There are but two people who can tell the story of a man's or woman's life, one is the person himself, and the other is the recording angel." Having no relationship or communication with the latter I may fail in my endeavor to interest you, but when we also recall that Dr. Holmes has written so freely about himself, in the end this paper may possibly become of interest.

An interest in the biography of medical men, as a pastime, has convinced me of its value as an educational factor. In the study of the biographies of the lives of some of the leaders in our profession, I have been impressed that the Hippocratic ideals are realized and exemplified in their lives. If, therefore, those teachers can enlighten us as to the darkness that went before, and the darkness that is to follow, let us hear what they have to teach us, and though we may not as yet perceive any special line of research, we may hold that every addition to our knowledge is one small step towards the great revelation. But let us proceed without further effusion.

Oliver Wendell Holmes, the son of Rev. Abiel Holmes, a clergyman of the Church of England, was born in Cambridge August 29, 1809. There is little of importance to record of his childhood, suffice it to state that at 15 he entered Philips Academy in Andover. Staying but a year in this institution he matriculated in Harvard in 1825, graduating with what is now known as the "Famous Class of Twenty-Nine." Contemplating the legal profession as his field of work, he studied law for one year in the Dane Law School. In answering the question as to why he relinquished the study of law to enter that of medicine, I can best do so by quoting his words:

> What determined me to give up law and apply myself to medicine I can hardly say, but I had from the first looked upon that year's study as an experiment. At any rate I made the change, and soon found myself introduced to new scenes and new companionships.

So from law Holmes turned to medicine. He says in his reminiscences:

> At the end of the first year in the Dane Law

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School, I took up my new study which was to be my final choice. There is something very solemn and depressing about the first entrance upon the study of medicine. The white faces of the sick that fill the long row of beds in the hospital wards saddened me and produced a feeling of awe-stricken sympathy. The dreadful scenes in the operating theatre, for this was before the days of ether, were a great shock to my sensibilities, though I did not faint as students occasionally do. When I first entered the room where students were seated at a table with a skeleton hanging over it, and bones lying about, I was deeply impressed, and more disposed to moralize upon mortality than to take up the task of osteology which lay before me. It took but a short time to wear off this earliest impression. I had my way in the world to make and meant to follow it faithfully. I soon found an interest in matters which at the outset seemed uninviting and repulsive, and after the first difficulties and repugnance were overcome I began to enjoy my new acquisition and knowledge. The head of the private school at which I studied was Dr. James Jackson, a very wise and a very good man, whose influence on the minds of his students who followed him in his visits to the hospital, and who listened to his teachings, was of the soundest and best character. Dr. Jackson never talked of curing a patient except in its true etymological sense of taking care of him. I think we may say in general that the doctor who talks of curing his patients belongs to that class of practitioners known in our common speech as "Quacks." It is in medicine as in surgery—nature heals; art helps, if she can, sometimes hinders, with the best of intentions; oftener is entirely ignored by the great remedial agencies, ordained by the shaping intelligence, which gives form and life to mortal organization.

Holmes attended two courses of lectures in this private school. If he was to be anything better than a rural dispenser of pills and powders he had to pass, at the very least, two years in European hospitals. Practically this must have been incorporated in the program when his choice of the medical profession was made. Yet so large a part of the "Consideration" received by clergymen was "good," rather than "valuable," that this foreign education would have been wholly impossible, had it not so happened that the daughter of a prosperous Boston merchant had brought with her into the clerical household a purse not altogether empty; and even with this aid, it would seem that some effort had to be made in order to send the young student to Paris with funds enough in his pocket to enable him to live comfortably, "like a gentleman," as he jealously expressed it. But his father and mother, like true New England parents of that day, came gallantly to the mark and equipped him.

More than once in his writings Holmes refers to his delightful student days in France where he was the follower of the great Louis. His valedictory address to his class in 1882 is largely made up of his reminiscences of his old Paris teachers. The following are his interesting comments on Lisfranc and Ricord.

Of Lisfranc, I can say little more than that he was a great drawer of blood and hewer of members. I remember his ordering a wholesale bleeding of his patients, right and left, one morning when a phlebotomizing fit was on him. I recollect his regretting the splendid guardsmen of the old Empire, *for what?* —because they had such magnificent limbs to amputate. I got along as far as that with him when I ceased to be a follower of Lisfranc.

Speaking of Ricord, Holmes says:

There was also the "Vivacious Ricord," whom I remember calling the Voltaire of Pelvic Literature, a skeptic of the morality of the race in general, who would have submitted Diana to treatment with his mineral specifics and ordered a course of blue pills for the vestal virgins.

Late in November of 1835 he returned to Boston and commenced the practice of his profession in January, 1836. In 1847, he was appointed Parkman professor of anatomy in Harvard, which chair he held for thirty-five years.

As the story of his life goes on it is now that he commences to attract the attention of his friends, and inspires by his life

the enduring reverence of posterity. Follow me while I lead you, somewhat hurriedly, through the succeeding years by portraying him in the rôle of *Anatomist*, and medical *Essayist* with an occasional citation of incidents that reveals the broadness of his character and mind.

ANATOMIST

That Holmes should have selected anatomy and dissection as his province of labor may seem a little odd when we are told that he was too tender hearted to practice medicine. Here is what two good witnesses, who have been placed upon the stand, deponeth to his point. Dr. Cheever says:

> Too sympathetic to practice medicine, he soon abandoned the art for the science, and always manifested the same abhorrence for death and tenderness for animals. When it became necessary to have a freshly killed rabbit for his lectures, he always ran out of the room, left me to chloroform it, and besought me to not let it squeak.

Professor Dwight says:

> In spite of the attention bestowed on dissection, I do not fancy that he much fancied dissecting, though the museum still has some few specimens of his preparation. Once he asked me what part of anatomy I liked best, and on my saying the bones, he replied, "So do I; it's the cleanest."

To better present to you Dr. Holmes in the rôle of anatomist permit me to describe one of his lecture hours. It nears one o'clock, and the work in the demonstrators' room in the old Medical school in North Grove Street becomes even more hurried and eager as the lecture hour in anatomy approaches. Four hours of busy dissection have unveiled a portion of the human frame, insensate and stark on the demonstrating table. Muscles, nerves, and blood vessels unfold themselves in unvarying harmony, if seeming disorder, and the subject is nearly ready to illustrate the lecture. The room is thick with tobacco smoke. The winter light, snowy and dull, enters through one tall window, bare of curtains, and falls upon a lead floor. The surroundings are singularly bare of ornament or comfort or beauty, and there is naught to inspire the intellect or imagination, except the marvelous mechanism of the poor dead body which lies dissected before us, like some complex and delicate machinery whose uses we seek to know. To *such* a scene enters the *poet*, the *writer*, the *wit*, Oliver Wendell Holmes. Few readers of his prose or poetry could dream of him as here, in this carnal house, in the presence of death. The very long and steep flight of stairs leading up from the street below resounds with a *double* and labored tread, the door opens and a small, gentle, smiling man appears, supported by the janitor, who has often been called to help him up the stairs. Entering, and giving a breathless greeting, he sinks upon a stool and strives to recover his asthmatic breath. Anon, recovering, he brightens up and asks, "What have you for me today?" and plunges, knife in hand, into the depths of his subject. Time flies, and a boisterous crowd of "turbulent Bob Sawyers" pours through the hall to his lecture room door and begin a rhythmical stamping and shouting and pounding. The doors open, a rush takes place, some collapse, some are thrown headlong and three hundred raw students precipitate themselves into a bare and comfortless amphitheatre. Meanwhile the Professor has been running about, now as nimble as a cat, selecting plates, rummaging dusty museums for specimens, arranging microscopes and displaying bones. The subject is carried in on a board; no automatic appliances, no wheels with pneumatic tires, no elevators in those days. The cadaver is decorously disposed on a revolving table, and is always covered with a clean white sheet. Respect for pure humanity and admiration for God's divinest work is the first lesson and uppermost in the poet-lecturer's mind. He enters and is greeted with a shout and stamp of applause. Then silence and there begins a

charming hour of description, analysis, simile and anecdote, which clothes the dry bones with poetic imagery, enlivens a hard and fatiguing day with humor, and brightens to the tired listeners the details of a difficult, though interesting, study. We may say tired listener because the student is now listening to his fifth consecutive lecture that day, beginning at nine o'clock and ending at two. No rest, no recovery for the dazed senses, which have tried to absorb materia medica, chemistry, practice and obstetrics all in one morning. One o'clock was always assigned to Dr. Holmes because he alone could hold his exhausted audience's attention. He came in with a grave countenance. His shoulders were thrown back and his face bent down. No one realized better than he that he had no easy task before him. He had to teach a branch repulsive to some, difficult to all; and he had to teach it to a jaded class which was unfit to be taught anything. The wooden seats were hard, the backs straight and the air bad. The effect of the last was alluded to by Dr. Holmes in his address at the opening of the new school in 1883, in which he referred to those early days as follows:

> So when the class I was lecturing to was sitting in an atmosphere once breathed already, after I had seen head after head gently declining and one pair of eyes after another emptying themselves of intelligence, I have said inaudibly, "Sleep on dear youth, this does not mean that you are indolent or that I am dull; it is the partial coma of commencing asphyxia."

To make head against these odds he did his utmost to adopt a sprightly manner and let no opportunity for a jest escape him. These would be received by quite appreciation by the lower benches, and with uproarious demonstration from the mountain, where, as in the French Revolution, the noisiest spirits congregated. He gave his imaginations full play in comparisons often charming and always quaint. None but Holmes could have compared the microscopical coiled tube of a sweat gland to a fairy's intestine. You will appreciate the aptness of his likening the mesentery to the shirt ruffles of a preceding generation. He has compared the fibers connecting the two symmetrical halves of the brain to the band uniting the Siamese twins.

As a lecturer he was accurate, punctual, precise, unvarying in patience over detail, and though not an original anatomist in the sense of a discoverer, yet a most exact descriptive lecturer; while the wealth of his illustrations, comparisons and similes was unequalled. Hence his charm. The student received information and was amused at the same time. He was always simple and rudimentary in his instructions. His flights of fancy never shot over the hearers' heads. Iteration and reiteration was his favorite motto in teaching. "These gentlemen," he said on one occasion, pointing out the lower portion of the pelvic bones, "are the tuberosities of the ischia, on which man is designed to sit and survey the works of creation." On another occasion in picking up a female pelvis and pointing to the pubic arch he said, "Gentlemen this is the Triumphal Arch under which every candidate for immortality must pass." But if witty, he could also be serious and pathetic, and he possessed the high power of holding and controlling his rough auditors. In earnest himself, enthusiastic, and of happy temperament he shed the glow of his ardent spirit over his followers and gave to his students some of the most attractive and happy hours of their life.

ESSAYIST

We have not in mind only his contributions to medical science and literature, which, though overshadowed by his work in general letters, were many and important, but we are thinking of that wider province of the physician that lies beyond the laboratory, the drug shop, the hospital and the consulting room, *the education of the public at large*. Dr. Holmes never lost sight of his profession, and he never

allowed the world to lose sight of it. Throughout his writings from "The Fly in the Stethoscope" to the good-natured raillery at a too exclusive specialism in "Over the Tea Cups," he did not hesitate to hit at its weakness and foibles; while apart from the admirable characters in his novels, he has in many noble passages pictured the life and influence of the true, modest and sacrificing doctor, in terms of the highest appreciation. Holmes is best known to English readers through the Breakfast Table Series, the Autocrat, the Professor and the Poet. These were all written when our author was comparatively young. They contain less direct reference to medical ethics than some of his later works, but even in these we note some very pertinent sayings. In the "Later Day Warnings," a short poem in the Autocrat, after dilating on the duties of legislature, haberdashers, preachers and property dealers, there is a fund of philosophy in these two lines:

> When lawyers take what they would give
> And doctors give what they would take.

He evidently despairs of the attainment of this high ideal, for he ends by saying.

> But when you see that blessed day
> Then order your ascension robe.

The medical elements are much more noticeable in the "Professor." The following lines are worth remembering by those of us that are apt to look upon ourselves, in our professional capacities, as in the world but not of it.

> You can't keep gas in a bladder, and you can't keep knowledge tight in a profession. Hydrogen will leak out and air will leak in, and special knowledge will leak out and general knowledge will leak in, though a profession were covered with twenty thicknesses of sheep-skin diplomas. Till common sense is well mixed with medicine and common manhood with theology, and common honesty with law, we, the people, will crash down upon the lumps of nonsense in all of them, till we have made them like Aaron's calf.

In our relation with patients we might well bear in mind the professor's advice to those about making a choice of a physician:

> Be sure you get one with a serene and cheerful countenance. A physician is not, or ought not to be an executioner; and the sentence of death upon his face is as bad as a warrant for the execution signed by the Governor. As a rule no man has the right to tell another by word or look that he is going to die. It may be necessary in an extreme case, but as a rule it is the last extreme of impertinence which one human being can offer to another.

In a discussion as to whether the art of healing makes men hard hearted and indifferent to human suffering, we have a delightful sketch of the ideal doctor in these words:

> You may be sure that some men, even among those who have chosen the task of pruning their fellow creatures, grow more and more thoughtful and truly compassionate in the midst of their cruel experience. They become less nervous but more sympathetic. They have a truer sensibility of others pains, the more they study pain and disease in the the light of science.

In the Poet, the last of this series, there are some very amusing and highly instructive references to young Doctor Franklin. The following may remind us all of our younger days:

> The young doctor has a very small office and a very large sign with a transparency at night big enough for an oyster shop. These young doctors are particularly strong in what they call Diagnosis, an excellent branch of the healing art, full of satisfaction to the curious practitioner who likes to give the latin name to one's complaint; not quite so satisfactory to the patient. Sometimes, in fact, one would rather not know the exact name of his complaint, as, if he does, he is liable to look it up in a medical work, and if he reads, "This terrible disease is attended with vast suffering and is inevitably mortal," or any such statement, it is apt to affect him unpleasantly.

The description of the doctor's office is racy, and I cannot pass on without

relating Holmes description of a patient's interview. I crave your indulgence in this quotation:

With superhuman air of sagacity, with much corrugation of the forehead and fearful concentration of attention Doctor Franklin examined the discolored spot. After dwelling on this most interesting and rare affection and asking if there were any objections to showing the case to the Society of Medical Improvement and Medical Observation, hints are given about Morbus Addisonii. So he gave the patient a prescription, "which," said the poet, "I took care to put where it could do no hurt to anybody, and I paid him his fee, which he took with the air of a man with a great income and said Good Morning. My landlady on seeing the same spot said it was a bump, recommended a piece of brown paper dipped in vinegar; the discoloration soon disappeared." The next interview after Dr. Franklin had had more experience was more satisfactory. The Poet had an ugly cut from a carving knife. It was astonishing to see what a little experience of miscellaneous practice had done for him. He did not ask any more questions about predispositions on the maternal and paternal sides. He did not examine me with the stethescope and laryngoscope. He only strapped my cut and informed me that it would speedily get well by "first intention."

Dr. Holmes has written three novels all full of medical interest, namely, "Elsie Venner," "The Guardian Angel." and "Moral Antipathy." To begin with "Elsie Venner," this is not the time or place to describe the plot or purpose of the story. I shall therefore dwell on those parts referring to our subject matter. Towards the end of the book we have the following description of Doctor Kettredge:

The old doctor was a model for visiting practitioners. He always came into the sick room with a quite, cheerful look, as if he had a consciousness that he was bringing some relief with him. The way a patient snatches the first look at a doctor's face, to see whether he is reprieved, whether he is unconditionally pardoned or whether he is doomed, has something terrible about it. It is only to be met by an impenetrable mask of serenity, proof against anything and everything in a patient's aspect. The physician who reflects his patient's condition, like a mirror, may do well enough to examine people for a life insurance office, but does not belong to the sick room. The old doctor came to her (Elsie's bedside), in such a natural quite way, that it seemed that he was only a friend that had dropped in for a moment to say a pleasant word.

In the "Guardian Angel," a delightful story, we will dwell but a moment on one comment of Dr. Holmes on the condition of Myrtle Hazard after she calms down from a series of hysterical attacks. Holmes utters these weighty words:

But all this series of mental disturbance left her in a very impressive state of mind and an excitable condition. This was just the state to invite the spiritual manipulations of one of those theological practitioners who considers that the treatment of all morbid states of mind, short of raving madness, belongs to them and not to the doctors. The same condition was equally favorable for the operations of any professional experimenter, who would use the flame of religious excitement to light the torch of an earthly passion. So many fingers that begin to play on the black keys, stray to the white ones before the tune is played out. Evidently from this we may conclude that the Emmanuel Movement is not of recent origin.

There are many short sayings in this volume which plainly indicate how high Holmes' ethical ideas were. In reference to Myrtle's case I again quote as follows: "Few households have ripened a growth of womanhood without witnessing some of these hysterical manifestations, and its phenomena are largely traded in by scientific pretenders and religious fanatics."

I shall be content with only one more extract from the third volume, in many ways a remarkable book. I refer to "Moral Antipathy." It refers to the ethics of doctors' discussing matters of private interest with their wives. I shall not enlarge as Holmes exactly hits off the danger as follows:

Dr. Butts carried these questions with him. His wife was a sensible, discreet woman,

whom he could trust with many professional secrets. He told her of Paolo's revelation, and talked it over with her in the light of his experience and her own. Mrs. B . . . buried the information in the grave of her memory where it lay for nearly a week. At the end of that time it emerged into a confidential whisper to her favorite sister-in-law, a perfectly safe person. Twenty-four hours later the story was all over the village. Dr. Butts resolves that he would be a little more careful the next time, at any rate, and in spite of every wish to be charitable, he concludes that the worthy lady must have forgotten the rule that "A Doctor's patients must put their tongue out, and a Doctor's wife must keep her tongue in."

From the number of his purely scientific writings on medical subjects, one will always be recalled, "Puerperal Fever as a Private Pestilence." The high estimate in which this work of Holmes is held is demonstrated by the frequent references made to it today by writers on obstetrics. Presuming that all of you have read this medical classic, I am going to quote but one paragraph that has always appealed to me:

It is as a lesson rather than as a reproach that I cal up the memory of these irreparable errors and wrongs. No tongue can tell the heart-breaking calamities they have caused; they have closed the eyes just opened upon a new world of life and happiness; they have bowed the strength of manhood into dust; they have cast the helplessness of infancy into the stranger's arms, or bequeathed it with less cruelty, the death of its dying parent. There is no tongue deep enough to record, and no voice loud enough for warning. The woman about to become a mother, or with her new-born nfant upon her bosom, should be the object of trembling care and sympathy where ere she bears her tender burden or stretches her aching limbs. The very outcast upon the street has pity upon her sister in degradation when the seal of promised maternity is pressed upon her. The remorseless vengence of the law brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claims for mercy. The solemn prayer of the litany singles out her sorrows from the multiplied trials of life, to plead for her in her hour of peril. God forbid that any member of the profession to which she intrusts her life, doubly precious at that eventful period, should regard it negligently, unadvisedly or selfishly.

Was ever a more beautiful plea made for the expectant mother? Its sentiment is still applicable today.

In the Professor at the Breakfast Table, in comment on this essay, Holmes says:

When by the permission of province I held up to the profession the damnable facts connected with the conveyance of poison from one young mother's chamber to another, for doing which humble office I desire to be thankful that I have lived, though nothing else should come from my life, I had to bear the sneers of those whose position I had assailed, and, as I believe, have at least demolished, so that nothing but the ghosts of the dead women stir among the ruins.

The inquiry is often made as to the exact reason why Dr. Holmes relinquished the practice of medicine. The cause may be found in his farewell address as follows:

Let me begin with my experience as a medical student. I had come from the lessons of Judge Story and Mr. Ashmun in the Law School at Cambridge. I had been busy more or less with the pages of Blackstone and Chitty and other text books of the first year of legal study. More or less I say but I am afraid it was rather less than more. During that year I first tasted the intoxicating pleasure of authorship. A college periodical conducted by friends of mine tempted me into print, and there is no form of lead poisoning which more rapidly and more thoroughly pervades the blood, bones and marrow than that which reaches the young author through mental contact with type metal. "He who has once been a drinker will drink again," says the French proverb, and so the man or woman who has tasted type is sure to return to his old indulgence sooner or later. In that fatal year I had my first attack of lead poisoning and I have never quite gotten rid of it from that day to this. But for that I might have applied myself more diligently to my

legal studies, and carried a green bag in place of a stethoscope and a thermometer up to the present day.

Proud as we are to think of him as a member of our profession, and proud as we are of his achievements in it, we realize that his great work in life had more to do with making people better spiritually than making them well physically. Physician by education, he devoted himself to practice and the acquistion and imparting of scientific knowledge. Poet by nature, he spent his leisure time and declining years in those writings which have so endeared him wherever they have been read. Philosopher, by thoughtful study and love for his fellow men, he made, for many, life's path less rugged by kind and philanthropic words.

The Doctor glided gently and imperceptibly into the period of old age. He came to it in excellent condition both of mind and of body, for he had led a well-regulated life. He had been a hard-working, but never really overworked man, and he had never taken either work or play nervously or tensely. Above all, he had been little preyed upon by anxieties; in the middle path between proverty and riches, with good company, he moved along amid the changing shade of sunshine, by the enchanted hedgerows, enjoying all the possible beauty and peacefulness of the journey through life, In this way he became old by degrees and hardly knew it.

Death drew near with steps so slow, so gently graded that the approach was hardly perceptible. He was out of doors taking his usual walks a few days before the end. He was up and about the house on the last day, and he died, in his chair, painlessly, as so humane a man well deserved to make his escape out of life, on October 7, 1894.

So passed a way one of the most lovable and notable figures of medicine. A personality pregnant with the perfume of ripe old age, and leaving recollections of a rarely perspicuous and sympathetic insight, a playful and pungent but not caustic humor, and a persuasive benevolence, which was far reaching but discriminating.

Among all his interests two were dominant and transcendent, medicine and literature. By the first he is known to more than a third of a century of students and to the whole medical world, by the second he is known throughout the entire English-speaking world.

In the rush and hurry of our restless life it may be well for us to look back upon the lives of some of the leaders of old, and if by so doing the tension of our mental alertness receives a healthy relaxation, we may consider the time thus spent as not wasted.

"I have only made a nosegay of culled flowers, and have brought you nothing of my own, but the thread that ties them together." Montaigne.

REFERENCES

Morris, J. T., Holmes' Life and Letters.
Holmes' Medical Essays.
Boston M. & S. J., vol. 131.
Scribners' Mag., 1889.
Provincial M. J., 1889.

Author's Note: All claims for originality are waived. This is but a compilation of extracts and paragraphs of many articles that have been read and to whose authors full credit is given for that which I have assembled in an endeavor to transmit a word picture of Dr. Holmes.

F. C. W.

BOOK REVIEWS

A History of the Medical Department of the United States Army. By Colonel P. M. Ashburn. Bost., Houghton Mifflin Co., 1929.

The Librarian of the Library of the Surgeon's General Office should be the logical person to write a well-documented history of the Medical Department of the United States Army. Colonel Ashburn, the present incumbent of this position, has done the work well. He has not only succeeded in presenting an accurate, authentic work of reference but at the same time has written a volume which makes

interesting reading and he has succeeded in giving what is really an outline of the history of medicine in America. As General Ireland says in the introduction, the story of this department is "a story of honest effort, of continual striving, of unselfish service, of steady improvement, of very honorable and very great achievement, a story we should like for the world to know." General Ireland is too modest in his statements. The story is one that the world of medical men at least *should* know. The story is one of organization, of scientific investigation, of heroism and self-sacrifice. Called upon in the Army posts to handle the usual functions of the family physician, the medical department of the United States Army is at the same time required to handle the most intricate problem of tropical medicine. The laboratory and operating room are of equal importance to this department.

Colonel Ashburn tells his story chronologically and divides it into six parts. Part I covers the Revolution, the War of 1812, the Indian Wars, the Mexican Wars and the Civil War. Parts II and III take from 1873 through the Spanish-American War. Part IV covers the interim between the Spanish-American War and the World War. The latter is covered in Part V, Part VI bringing the work from the World War to date. This volume offers to the surgeon of today not only a literary treat but many surprises as to the activities and interest of "our medical department." If this book is purchased by only a small number of those who *should* read it, a new edition will soon be called for.

Biographisches Lexikon der hervorragenden Ärzte aller Zeiten und Völker. Zweite Aufl. herausg. und bearb. von Dr. med. et phil. Franz Hübotter, Berlin. Erster Bd. Aaskow—Chavasse. Mit 64 Bildnissen, 936 Zeite. Berlin, Urban & Schwarzenberg, 1929.

"Hirsch's Biographisches Lexikon," published in 1883, has long been the chief source dook for biographic material for medical historians. Out of print for some time, it has of recent years been high priced and unavailable to most historians. The new edition is, therefore, particularly welcome at the present time when interest in medical history is being stimulated in all directions.

Carefully edited, printed in a type easy to read, typographically well arranged and with a splendid collection of portraits, with biographic material as to dates of birth, death and publications readily accessible, the new edition will form a necessary part of the armamentarium of everyone interested in medical history. This today should include practically everyone practising medicine. The new edition is to be complete in 6 volumes, of which only the first is published. We look forward with keen anticipation to the publication of the other volumes and if they are the equal of the one before us, the set will leave little to be desired.

Among the Americans in the present volume are William B. Beaumont, Gurdon B. Buck, J. M. A. Allen, Timothy F. Allen, Henry F. Campbell, John B. and Samuel Bard, etc., from which it will be seen that the" Lexikon" is rather complete.

It is unfortunate to find Sir Thomas Clifford A. Allbutt's name spelled "Alibutt," but a few misprints are unavoidable in a work of this kind and undoubtedly will be taken care of in the reprints.

Kyklos. Jahrbuch des Instituts für Geschichte der Medizin an der Universität Leipzig. Band I. 172 pp. 1 illus., 1928. Band II. 299 pp. 9 illus., Leipzig, Georg Thieme, 1929.

The first volume, published in January, 1928 and the second of January, 1929, give indications of year books that will be expectantly looked forward to by all interested in medical history. That Volume II should be dedicated to our own Dr. William H. Welch and have his portrait as a frontispiece is a particularly apt tribute at this time when the Welch Institute for Medical History has ust been opened in Baltimore. The splen did dedicatory foreword to Dr. Welch is but another example of the internationalism of science. A list of the contents of each volume is appended. The authors and subjects need no comments. No student of the history of medicine will want to be without these volumes and every physician would profit by their perusal. The contents of the two volumes follow:

VOLUME I:

Vorwort.

I. Abhandlungen aus dem Institute. Der systematische Zusammenhang im Corpus Hippocraticum. Von Owsei Temkin. Zur Grundstruktur der paracelsischen Naturwissenshaft. Von J. D. Achelis. Time-implied Function: an historical Aperçu. By Stephen d'Irsay. Kultur und Krankheit. Von Henry E. Sigerist. Die Alliumarten im Gebrauch der abendländischen Medizin. Von Kurt Heyser Sapientia

artis medicinae. Ein frühmittelalterliches Kompendium der Medizin. Von M. Wlaschky. Ein frühmittelalterlicher Botanicus. Von Erhardt Landgraf.

II. Aus Forshung und Lehre der Medizingeschichte. Die Geschichte der Medizin im akademischen Unterricht. Ergebnisse einer Rundfrange des Instituts. Von Henry E. Sigerist. An historical Dictionary of Medicine. By Stephen d'Irsay.

III. Bericht über die Tätigkeit des Instituts im Jahre 1926/27. Register.

VOLUME II:

Vorwort.

I. Abhandlungen aus dem Institut.

Die Sonderstellung des Kranken. Von Henry E. Sigerist. Studien zum "Sinn"-Begriff in der Medizin. Von Owsei Temkin. 1. Kritischlogische Voruntersuchung. 2. Krankengeschichte und Sinnsphäre der Medizin. 3. Moliere und der Sinn der Medizin im 17. Jahrhundert. 4. Epidermiologie und Geschichte der Medizin. Virchow. Von Ernst Hirschfeld. A physiological synthesis. By Stephen d'Irsay. Fragmente zur Arzneigeschichte. Von Hermann Scheer. 1. Warum treiben wir heute Geschichte der Heilmittel? 2. Einleitung zur Geschichte einer Heilpflanze. 3. Mensch und Pflanze. Studien zur Geschichte der Heilpflanzen. 1. Lilium convallium. Von Ernst Hirschfeld. 2. Scilla. Von Ernst Hirschfeld. 3. Zur Geschichte der medizinischen Verwendung des Safran (Crocus sativus). Von Maria Tscholakowa. Die Personallehre in der Naturphilosophie von Albertus Magnus. Von Claudius Franz Mayer. Diätetische Wundbehandlung im Mittelalter. Von August Wilhelm Bock. Eine Beschwörung der Gebärmutter aus dem frühen Mittelalter. Von Werner Bernfeld.

II. Aus Forschung und Lehre der Medizingeschichte. Bibliographie der medizingeschichtlichen Arbeiten Karl Sudhoffs aus den Jahren 1923–1928. Nach Materien geordnet von Grete Herbrand.

III. Bericht uber die Tägkeit des Instituts im Jahre 1927/28 Register.

THE VOLUME OF THE BLOOD AND PLASMA IN HEALTH AND DISEASE. By Leonard G. Rountree, M.D., and George E. Brown, M.D., with the Technical Assistance of Grace M. Roth. Phila., W. B. Saunders Co., 1929.

This modest volume is a Mayo Clinic Monograph and its value is guaranteed by the authors, alone, even though the subject is one of great present-day importance. Every general practitioner who pretends to thorough scientific work and every internist may well spend two or three hours with this book. W. J. Mayo says in the Foreword: "Studies of blood volume give a new outlook on many problems which long were considered settled . . . The pure science of to-day is the applied science of tomorrow."

This book presents the evidence which has accumulated during the last few years relative to observations made with the dye method. The authors have shown the value of the study of the blood volume and plasma volume in clinical medicine.

We earnestly recommend this book.

THE LIFE OF HERMANN M. BIGGS, M.D., D.SC., LL.D. Physician and Statesman of the Public Health. By C.-E. A. Winslow, DR. P.H. Phila., Lea & Febiger, 1929.

We are here offered the life history in simple language of one of the outstanding figures in modern American medicine. Some of the interesting sidelights taken up include medical science, hospital organizations, public health work and politics from 1859 to 1923. As Dr. Welch says in his preface "Biggs had a genius for leadership and has been justly called a sanitary stateman." The book should prove a source of inspiration to every young physician and medical student. It is truly an idyll of American achievement.

DIE WIEDERBELEBUNG. By Oskar Bruns and Karl Thiel. Berl. Urban & Schwarzenberg, 1930.

This little book on resuscitation should be found interesting and valuable to physicians and surgeons connected with industrial plants. The claim is made by the author that with proper knowledge of resuscitation many an apparently hopeless case, suffering only from electrical shock, may be saved. The subject is well covered and should be in the medical library of every industrial plant today.

ESSENTIALS OF MEDICAL ELECTRICITY. By Elkin P. Cumberbatch, M.A., B.M. (Oxon.), D.M.R.E. (Camb.), M.R.C.P. Ed. 6, rev. & enl. 11 pl., 116 illus., 459 pp. St. Louis, C. V. Mosby Co., 1929.

The sixth edition of this book has been carefully brought up to date. It gives, as its title indicates, the "essentials of medical electricity" as understood at the present time.

PSYCHIATRIE DU MÉDECIN PRATICIEN. By M. Dide and P. Guiraud. Ed. 2. Paris, Masson et Cie, 1929.

Here is a modern, well-written and well-illustrated textbook on psychiatry written for

the general practitioner and of undoubted value to those reading French.

The Pathology of the Eye. By Jonas S. Friedenwald, M.D. N. Y., Macmillan Co., 1929.

"This book," says the author, "is the outcome of a course of lectures, . . . for the instruction of medical students and surgical house officers in the department of ophthalmology of the Johns Hopkins Medical School and Hospital." As far as may be done in a volume of 350 pages, the author has covered his subject well and, while not intended for specialists, as a comprehensive survey of the subject the book presents a splendid outline of the pathology of the eye for the non-specialist.

The Medical Museum. Based on a New System of Visual Teaching. By S. H. Daukes, O.B.E., M.D., D.P.H. Lond., Wellcome Foundation, Ltd.

This, the latest publication of the Wellcome Foundation, is not merely a theoretical discourse on medical museums but a report of definite progress. Everyone interested in museums from any angle will profit by a study of this book.

Aids to Orthopaedic Surgery. By Eric A. Crook M.Ch. (Oxon.), F.R.C.S. (Eng.). N. Y., William Wood & Co., 1929.

This volume on orthopedic surgery aims, according to the author, to cover only "that part of the subject of which knowledge is required of the student of general surgery." This purpose is accomplished by the book and not only the student but the general surgeon will find the scanning of this book an excellent method of refreshing his knowledge of orthopedic surgery.

Research and Medical Progress and Other Addresses. By J. Shelton Horsley, M.D., Richmond. 6 illus., 208 p. St. Louis, C. V. Mosby Co., 1929.

This volume of 15 essays by Dr. Horsley, of Richmond, Va., covers a great deal of ground as indicated by the following titles of the chapters: Research and Medical Progress; Physiology and Modern Surgery; The Influence of Physiologic Research on Modern Surgery; The Ideals of the Surgeon; The Career of a Surgeon; Shall Surgeons Tell the Truth?; Stomach Trouble; The Mimicry of the Symptoms of Peptic Ulcer; Peptic Ulcer and Cancer of the Stomach; Some Considerations Concerning the Treatment of Cancer; Modern Methods of Preoperative and Postoperative Treatment; The Medical Profession of Virginia; The Medical Profession of Virginia and State Medicine; Politics and Medicine; The Virginia Academy of Science—Our Fifth Estate. Dr. Horsley also has always something worth saying on each subject and says it well. The volume will repays the short time taken to read it.

Etudes sur Les Maladies Familiales Nerveuses et Dystrophiques. By O. Crouzon. 90 illus., 395 p. Paris, Masson et Cie, 1929.

This book with a preface by Prof. Pierre-Marie covers the subject in a complete and up-to-date manner and presents completely and concisely the ideas of the French school today. Every neurologist and neurosurgeon, who reads French, will want to add this book to his library.

Surgery of the Lung and Pleura. By H. Morriston Davies, M.A., M.D., F.R.C.S. Oxford Press, 1930.

This is a monograph in a series entitled Regional Surgery.

To any surgeon who wishes to keep abreast of the times this book is presented; to the surgeon who deals with affections of the lung and pleura we recommend this well-written and thorough addition to the literature. We feel that the casual surgeon should not attempt many operations made necessary by diseases of the lung and pleura; it is a field for the mature and especially well-trained man, but to the student of surgery and the growing assistant this volume will prove an invaluable aid.

In the last two decades surgery of the lungs and pleura is a bright light in the field of surgical advance and the author of this work handles his subject sanely and thoroughly; the reader soon senses he is reading a finished authority on the subject.

The Treatment of Varicose Veins of The Lower Extremities by Injection. By T. Henry Treves-Barber, M.D., B.Sc. N. Y., William Wood and Co., 1929.

This small book of 120 pages gives in every detail essential to the practitioner the technic of the injection treatment of varicose veins of the lower extremities. In a readable and concise manner the author covers the essentials of the modern ambulatory treatment of this common condition. In these days when many men attempt this treatment with an inadequate knowledge of the contraindications, possible complications during treatment and with no

knowledge of the pathology involved it would not be amiss to urge that this worthwhile book be in the hands of many of the profession.

Hemorrhoids. The Injection Treatment and Pruritus Ani. By Lawrence Goldbacher, M.D. Phila., F. A. Davis Co., 1930.

In the preface the author writes: "The purpose of this book is to present to the medical profession certain practical and readable information regarding hemorrhoids and pruritus ani. The aim has been to make it as brief and simple as possible." The author has succeeded. To any physician interested in these subjects we would be neglecting our duty if we did not write that this small book is a necessary part of the literature and just what a majority of busy doctors of medicine have been looking for.

Tonsil Surgery. By Robert H. Fowler, M.D. Phila., F. A. Davis Co., 1930.

To the true laryngologist this book will prove interesting and the reader will be pleased with the excellence of the publishers' part of bringing it out. The type is large and the illustrations (half-tone and colored) are well reproduced.

To the man who thinks tonsil operations are a part of the general practice of medicine we would like to be able to command that this book must be read ten times and then studied for two years. After this course of reading and study we feel he would be an aid to the public and really know how to do tonsil surgery. That the author has accomplished his aim is sufficient recommendation to any who feel they want a book on this subject.

Treatment in General Practice. By Harry Beckman, M.D. Phila., W. B. Saunders Co., 1930.

This is a necessary book to most physicians. The average student graduates from a medical school well grounded in pathology, physical diagnosis, etc., and except for a few inadequate lectures, it is left to the future for him to discover how to treat his patients. Very often this is accomplished by the literature of drug houses and the beguiling tongues of detail men. And so Dr. Beckman's book is thrice welcome. We will not go into details but merely leave you with this instruction: If you practice medicine and want a handy book to which you can turn to guide and find advice when in a quandary as to treatment this work is the one we hint that you will not go amiss in buying.

The Treatment of Common Disorders of Digestion. By John L. Kantor, Ph.D., M.D. Ed. 2. St. Louis, C. V. Mosby Co., 1929.

The second edition of this book follows closely the lines of the first edition. Three new chapters have been added on "Common Anomalies of the Colon," "Irritable Colon (Colitis)," and "Organic Diarrheas." There is new material on the vitamines, neutral antacids, cardiospasm, modified Sippy diet, surgical treatment of ulcer, after-treatment of ulcer, etc. For a practical survey of the treatment of the common disorders of digestion the book may be highly recommended.

Mammalian Physiology. A Course of Practical Exercises. By E. G. T. Liddell, D.M., and Sir Charles Sherrington, O.M., M.D., D.SC., F.R.S. Ed. 2, Oxford Univ. Press, 1929.

This is a laboratory book which should prove invaluable to the student of physiology. Having stood the test of two editions, and written by that master physiologist, Sir Charles Sherrington, it may be considered today the last word on the subject.

Acute Infectious Diseases. By J. D. Rolleston, M.D. Ed. 2. Lond., Wm. Heinemann, 1929.

The first edition of this book was published four years ago and the second edition has brought those chapters in which advances have been made up to date. The principal changes have been made in the chapters on diphtheria, typhoid fever, scarlet fever, measles, smallpox and vaccinia. The fact that only one paragraph is devoted to undulant fever and one to tularemia will probably be disappointing to American physicians. It is to be hoped that in the next edition these subjects will be more elaborately treated. The systematic method of handling the subject, the simple language, and the evident authority with which the author speaks make this book an interesting work of reference.

SUPPLEMENT TO

The American Journal of Surgery

A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

EDWARD M. LIVINGSTON, M.D.

SECTION I. THE CAVITY (CONTINUED)

[In the following pages the Journal page number will be found at the bottom of the page.]

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A CLINICAL STUDY OF THE ABDOMINAL CAVITY AND PERITONEUM

Section 1. The Cavity*

C. THE ABDOMINAL WALLS

2. The Bony Walls (Continued)

The Lumbar Curvature of the Spine

THE shape of the abdominal cavity is basically that of a truncated ovoid, but the symmetry of this figure is destroyed by the ingrowth, on the posterior wall, of the vertebral column. The cavity is narrower in the anteroposterior than in the transverse diameter and the narrowest point is situated over the fourth and fifth lumbar vertebrae, or just above the sacral promontory (Fig. 35). During physical examinations this prominent vertebral mass may sometimes be felt, when palpating the anterior abdominal wall. By bearing in mind how closely the anterior and posterior walls may approach one another in the lower lumbar region, the clinical blunder of mistaking the vertebral mass for some abnormality within the peritoneal cavity may be avoided. In confusing cases palpation is best conducted beneath a fluoroscopic screen.

Palpating the Abdominal Aorta

The abdominal aorta courses along the anterior surface of the vertebral column, running slightly to the left of the midline, and bifurcating at the level of the fourth lumbar vertebra to form the right and left common iliac arteries. It may be mistaken during palpation for a pulsating tumor (aneurysm or solid tumor overlying the aorta). There are instances in which this great vessel may actually be rolled from side to side beneath the palpating fingers as an elongated cordlike mass (Fig. 35, note 2). As a result the diagnostician

* Preceding installments have appeared as follows: January issue, p. 193; February issue, p. 460.

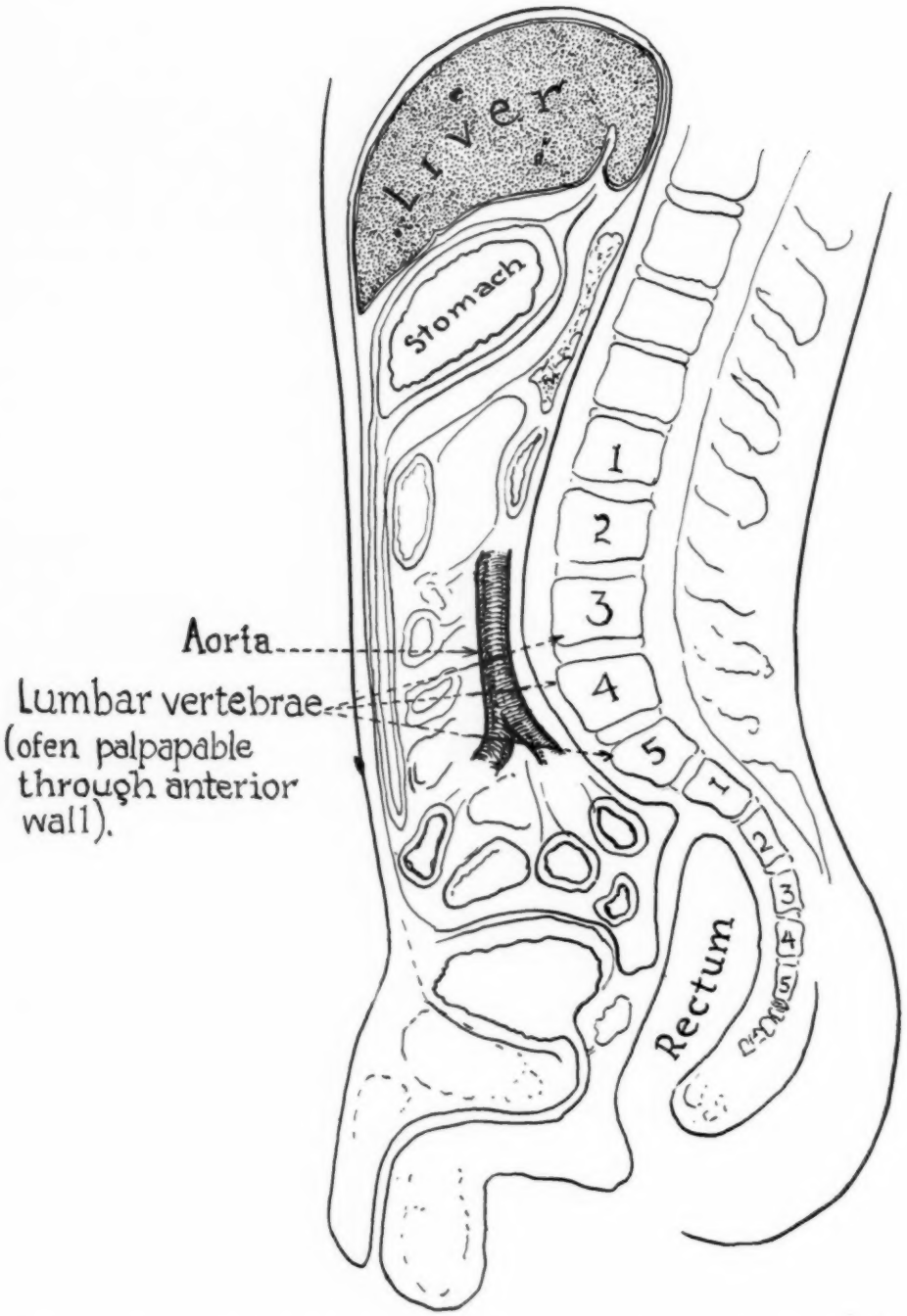

FIG. 35. Cross section of abdomen showing the narrow anteroposterior diameter in the lumbar region.

Note. 1. The vertebral column is often palpable through the anterior abdominal wall and may be mistaken for an abnormal mass.

2. The abdominal aorta frequently may be palpated immediately below the umbilicus.

3. A blow upon the anterior abdominal wall may cause injury or rupture of an intestinal loop by crushing the intestine against the vertebral column.

may be taxed to the limit in his effort safely to identify that which is normal and to exclude that which is abnormal. When the abdominal aorta is plainly felt during an examination, the information which it may impart should not be ignored. It is possible, through palpating this vessel, to estimate the cardiac rate, vigor and regularity. At times this information may be thus obtained with even greater facility than through feeling the radial artery, partially obscured, as it is, between the styloid process of the radius and adjacent tendons. The abdominal aorta is the largest palpable vessel in the body. When seeking other information by abdominal examination the surgeon should add to his observations such data as may be gained through palpating this artery, even though the additional information be recorded in an almost subconscious manner. By such a routine the attention need not be directly diverted to the vascular system but many gross circulatory abnormalities may automatically be detected.

Epigastric Aortic Pulsations

Within the *epigastrium* pulsations from the abdominal aorta are not normally felt. Thorkild Rovsing pointed out[41] that aortic epigastric pulsations occur here only with malpositions of the stomach; he wrote (clinical lectures):

> One perceives a distinct pulsation in the epigastric region, as I place my hand on the epigastrium, and I feel the aorta pulsating quite close to my finger; you can see, in fact, how my fingers rise and fall simultaneously with the pulse wave. You will never find this with individuals whose stomachs occupy their normal positions. It is merely due to the fact that the stomach, which usually covers the vertebral column like an air- or water-cushion, has glided down from its position into the lower abdomen. It is, therefore, a pathognomonic sign of gastroptosis.

The Anatomy of Hernias; Abdominal Incisions

3. *The Soft Parts as a Whole.* Much space is allotted in most surgical reviews of the abdominal walls to a study of incisions and of the anatomy of hernias. The present chapter, however, deals but little with either topic for both are subjects in which the operating surgeon is well versed and both are excellently presented for review in many readily obtainable texts. It has been said (Ochsner) that the "innumerable

abdominal incisions which have been described by, and bear the names of, innumerable surgeons" represent that type of non-essential information which exists in many surgical fields and serves to add needless confusion; it represents "a pedantry which often clutters and obstructs the profession." The present aim is intentionally to omit much that is elementary and to avoid confusing non-essentials. The primary object is to suggest new angles from which to consider surgical topics and to attain such an objective it is inevitable that routine values often be disregarded and a logical arrangement of material sacrificed. "To be truely a postgraduate study the topics must be elective." The anatomy of inguinal hernias, then, will be entirely omitted from discussion and details as to methods for incising the peritoneal cavity will be referred to only as the subject arises in other connections.

Injuries to the Abdominal Wall

The most important diagnostic problem in regard to wounds of the abdominal wall is to determine whether intra-abdominal structures have been simultaneously injured. It is well known that the same violence causing a simple or closed wound of the belly wall may also produce an open wound (rupture) in some viscus. Morgagni[42] described the mechanism by which the intestine might be crushed against the vertebral column while the anterior wall itself showed little evidence of injury (See Fig. 35, note 3). The literature on this subject has been reviewed by Royster[43] and others.[44] Correct diagnosis is of vital importance for when the pain, shock, tenderness and rigidity are due solely to a solution of continuity within the wall itself, laparotomy is needless; but in the presence of intraperitoneal hemorrhage or leakage of contents from some viscus, an immediate operation is imperative. When it seems certain that the anterior wall alone has been damaged the treatment consists essentially of securing muscular relaxation through posture (flexed thighs, elevated head) and of making appropriate local applications (wet dressings, straps); open wounds are closed in layers, with or without drainage; probing an abdominal

wound is inadvisable. When, upon the other hand, an intra-abdominal injury is known to have occurred, or is strongly suspected, and preparations are being made for operation, the patient should promptly be placed in a semi-sitting posture (Fowler or exaggerated Fowler position) in order to encourage the gravitation of fluids to the pelvis, and adequate doses of morphine should be administered to diminish shock and to quiet the intestinal musculature.

Abdominal Perforations

Complete perforation of the abdominal wall constitutes an indication for early exploration to allow prompt repair of damage to any viscus.[45] It has been stated that "the safest treatment for a stab wound that penetrates, or which is suspected of penetrating, is early, careful exploration."[46] About 90 per cent of all gunshot or stab wounds perforate some organ, or organs, over half being those of the intestinal tract. Isolated cases have been reported in which spontaneous closure of small perforations of bowel have undoubtedly occurred[47] and this is explained by the plugging of the aperture by redundant mucous membrane or by omentum and by a reduction of the size of the perforation through a reflex contraction of the intestinal muscles adjacent to the wound.[48] Upon the basis of such reports conservatism might seem permissible when the perforating foreign body is known to have been of small calibre and particularly when the wound is in the upper abdomen, the patient not in shock, and proper conditions for operation not at hand. Yet such delay based upon theoretical grounds and upon isolated or chance reports is not a true conservatism, for early favorable symptoms are frequently followed by sudden fatal collapse and the two chief causes of death following perforation are hemorrhage and peritonitis, neither of which brooks delay. Authorities,[43–45] almost without exception, agree that the outcome of untreated perforations of the intestinal tract is "practically a 100 per cent mortality." Delore went so far as to state that in 1500 cases no patient with a penetrating abdominal wound had recovered under conservative treatment.[49] Even with operative

interference the mortality following gunshot wounds of the abdomen has been found to be 50 per cent both for civil[50] and war practice.[51] It is definitely established, however, that the end-results bear a direct relation to the promptness of operation, just as is true of the operative results from acute peptic perforations where every hour of delay adds to the danger; and in 700 cases studied with reference to the time of operation the mortality varied from 18 per cent in those operated upon within four hours to 87 per cent where operation was delayed beyond twelve hours after injury.[52]

Evidences of Intra-Peritoneal Injury

Intra-abdominal damage is indicated by characteristic pain, vomiting, persistent shock, and evidences of internal hemorrhage or visceral leakage. (Fig. 36.) Included in this evidence may be dyspnea, rapid pulse, pallor, shoulder pain, hiccough, absence of liver dulness, shifting dulness in the flanks, leucocytosis, subnormal temperature, absent reflexes. The pain is deep-seated and widespread and is usually first referred to the umbilical region. Associated with shock is cold perspiration, typical pallor, respirations which are superficial and rapid, and a pinched and worried expression which is not readily mistakable. The shock is due to overstimulation and paralysis of the vital reflex centers, vasomotor and respiratory. The vomiting is a reflex through the vagus and it occurs immediately after the injury, but this may be followed by a persistent or recurrent vomiting, often of a mechanical type. Hemorrhage is indicated by a soft and rising pulse, by increasing pallor, "air hunger," and thirst; the leucocyte curve following subserous hemorrhage is characteristic,[53] the count rising rapidly within the first few hours to a 200 or 300 per cent increase above normal, reaching a peak before the sixth hour, and returning slowly to normal by the fourth day; thus interval blood counts studied with reference to the time after injury are of great value. The free fluid gives rise, at times, to shoulder pain, hiccough, and shifting dulness; free gas, even in small quantities, may cause an early obliteration of liver dulness (see section on Intra-abdominal Pressure).

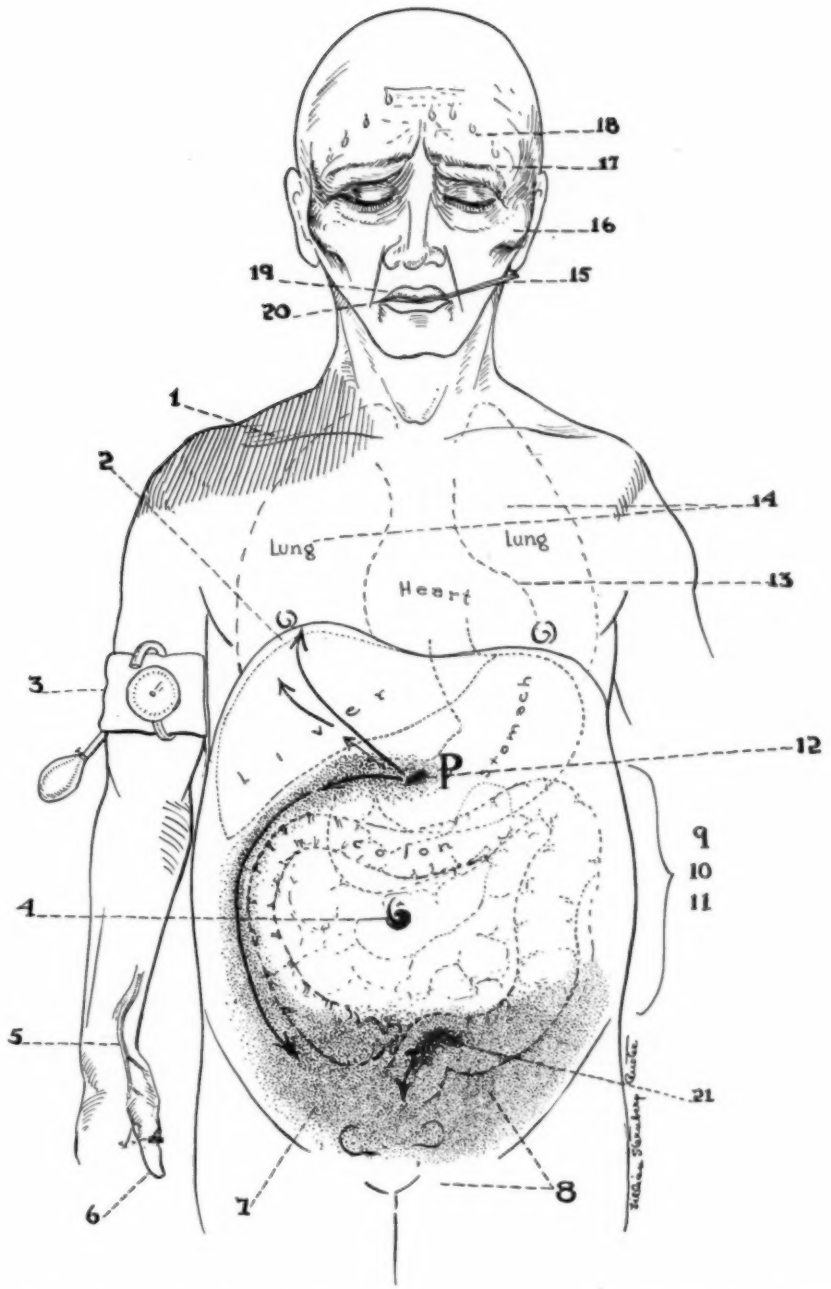

FIG. 36. Graphic study of some signs and symptoms caused by intestinal perforation.

1, Shoulder pain. 2, Free gas, obliterated liver dullness. 3, Altered blood pressure. 4, Umbilical pain. 5, Rapid pulse. 6, Blood cocent. 7, Free fluid. 8, Occult blood. 9, 10, 11, Tenderness, rigidity, dissolution of abdomen. 12, Epigastric pain. 13, Caped heart. 14, Dyspnea. 15, Subnormal temperature. 16, Polor. 17, Pinched expression. 18, Perspiration. 19, Hiccough. 20, Vomiting. 21, Clotted blood in rectum.

The local examination is of questionable value, since tenderness and rigidity accompany injuries to the abdominal wall as well as those to the viscera. These individual signs and symptoms will be minutely studied in the sections headed Visceral Neurology, The Intestinal Tract, The Solid Organs, and The Peritoneal Membrane. In addition to the general evidences of intraperitoneal involvement are the signs and symptoms of injuries to specific structures. For example, rupture of the bladder may be indicated by such findings as bleeding from the urethra, local extravasations of urine, and an empty bladder upon catheterization. Perforation of the diaphragm, with subsequent diaphragmatic hernia formation, should be considered after any perforating wound in the upper abdomen. Even though the indications of intra-abdominal injuries are numerous and well defined, the following conclusion has repeatedly been restated by many authorities:

> There is no sign, or combination of signs, sufficiently constant to indicate the nature of the injury in every case, or to serve as a basis for diagnosis. Exploration is the only definite means for making a diagnosis in season for effective treatment. To wait for definite intraperitoneal signs is often to wait too long, and we should not be deceived into a false sense of security by an improvement in the early symptoms.[54]

Muscle Strain in the Anterior Abdominal Wall

Simple strains of the muscles of the anterior abdominal wall may give rise to signs and symptoms which are readily mistaken for those from more serious affections such as early appendicitis, inguinal hernia, obstructions to the ureter. Such muscle strains should be chiefly thought of with two classes of patients: the young school girl who strains her oblique muscles from vigorous activities to which she has been unaccustomed and the middle-aged man when first resuming strenuous sports after having gained considerable weight.[55] It is important, then, in taking the history in atypical abdominal cases to include an inquiry into any unusual physical exertion during the preceding fortnight.

Desmoid Tumors

It is often difficult to determine whether a given palpable mass is located within the abdominal cavity or within the

abdominal wall. Tumors within the wall itself may exist anterior to the muscles, within the substance of the muscles or beneath the muscles; again, they may be herniated through the muscle layers. Those which are herniated may be detected by their impulse upon coughing; those beneath the muscles are obscured when voluntary rigidity occurs; those within the muscle become fixed and hard as the muscle is contracted whereas they were previously movable; and those situated above the muscles are rendered more prominent as the contractile tissue beneath is made tense. Neoplasms intimately connected with the abdominal muscles are rare, except for the variety known as desmoid tumors or the recurrent fibromata of Paget.[56] Among salient points concerning desmoids are the following; By definition the term means "resembling in appearance a tendon or ligament; ligamentous, tendinous; of firm texture, noting a fibroid or scirrhous tumor" (Gr. *desmos*, a band (tendon) + *eidos*, appearance or form). Desmoids arise, for the most part, in the posterior sheath of the rectus. Rarely are they found in the sheath of the oblique muscles. In three-fifths of all cases they arise in women during pregnancy and are here of rapid growth. This origin is presumably accounted for by minute tears in the muscle and fascia caused by stretching of the belly wall. With women the age incidence is from twenty-five to thirty-five (most active period of reproduction); with men, when desmoids arise, they occur between the thirty-fifth to the fiftieth years. The tumors may be multiple, but as a rule are single. There is a distinct predilection for the lower half of the abdomen and desmoids are more frequent on the right side than on the left. These masses may be slow in growth; when developing rapidly during pregnancy they may diminish in size after parturition. Their typical shape is spherical but this may be modified by the muscle fibers through which they are forced, hence the tumors may become ovoid, or flattened, or have a collar-button shape. When passing beyond their usual size of that of a walnut or egg they take on the characteristics

of a fibromyxoma or fibrosarcoma and may become huge. The typical tumors are hard and solid, with a firm capsule more or less adherent to surrounding tissue. On section the neoplasm has a definite sheen and a tendon-like appearance; it creaks under the knife; its center may show evidences of hemorrhage or calcification. Microscopically, in addition to the typical seeds there may be clusters of rapidly proliferating spindle or round cells and only the postoperative clinical history serves to definitely rule out the diagnosis of sarcoma and establish that of desmoid tumor.[57]

The Line of Congenital Anomalies and Embryonic Defects

The exact midline of the body has been referred to as "the line of embryonic defects." It represents the final site of closure between the two lateral walls of the trunk. Such defects as the following occur along the midline: umbilical hernia, patent urachus, persistent Meckel's diverticulum, epigastric hernia, ectopia vesicae, spina bifida, meningocele, dermoid tumor, imperforate anus. The trained clinician will consider the possibility of an embryonic origin in any tumor, cyst, or fistula which occupies the exact midline of the body. When aware of the congenital nature of the lesion the surgeon is prepared to take the special care or to adopt the special operative procedures usually required with this class of conditions.[58]

Epigastric Hernias

The linea alba between the navel and the ensiform cartilage is at times the seat of small masses varying in size from that of a walnut to that of an egg, known as epigastric hernias (Fig. 37A). The usual site of these little tumors is within 3 in. of the umbilicus. They are of congenital origin and may be of four varieties:[59] (1) Small masses of subperitoneal fat without a sac; (2) such fat tabs with the addition of processes of peritoneum, but without hernial contents; (3) a peritoneal sac containing omentum; (4) a peritoneal sac containing intestine (Fig. 37B). While symptoms may be absent they are often severe, including nausea, vomiting, hematemesis and epigastric pain. The diagnosis of peptic ulcer is often made in the presence of such symptoms, the congenital mass being entirely

overlooked. The confusing symptoms are due to the "dragging" on upper abdominal structures. An operative cure is not difficult to obtain through the use of the Mayo technic

FIG. 37A. The chemical picture of epigastric hernia. (From Quervain.)

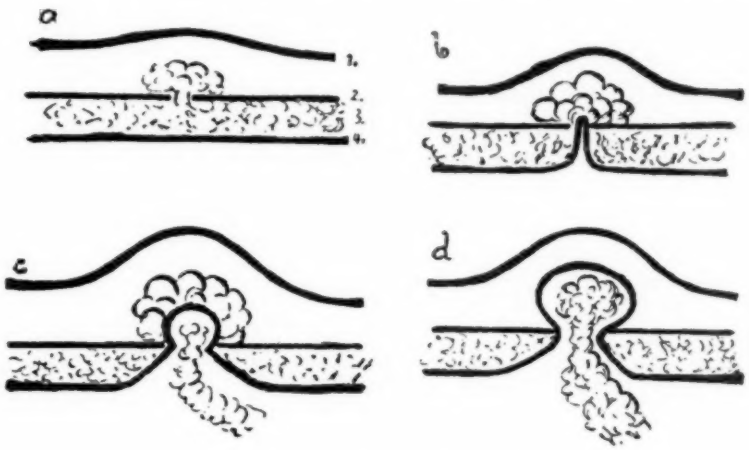

FIG. 37B. The anatomical varieties of epigastric hernia. (epigastric hernia and subserous lipoma). (From Quervain.)

(*a*) Subserous lipoma, after breaking through sheath of rectus. 1, Skin. 2, Rectus sheath. 3, Subserous fat. 4, Peritoneum.

(*b*) Subserous lipoma, with some peritoneum pulled up into facial slit.

(*c*) Subserous lipoma, with a hernial sac containing some protruded omentum. (Epigastric fatty hernia.)

(*d*) Simple epigastric hernia, without lipoma.

for dealing with small umbilical weaknesses. The removal of such tumors, though small, should only be attempted

under the most rigid aseptic conditions and under circumstances which make possible a much more extensive procedure than would at first seem required, including intra-abdominal manipulations.

The Navel

4. *The Umbilicus.* The umbilicus is of particular interest to the surgeon on account of its location, its permanent venous connections with the portal circulation and its historical relations to the bladder, intestinal tract, liver, vascular system, and peritoneal cavity.

The word umbilicus means (L.) a small pebble or button (the belly-button) and may be used in a non-medical sense for any object which resembles a little pebble, or again, for any small pit or fovea into which such a tiny pebble might fit (an umbilication). The central depression or umbilication of the abdominal wall is caused by an internal traction exerted by obliterated embryonic vessels (the ligaments of the umbilicus).

Spontaneous Cure of Umbilical Hernia in Infancy

This traction accounts for the spontaneous cure shortly after birth of most congenital umbilical weaknesses. The central location of the umbilicus is implied in the synonym, navel, for, as the hub of a wheel is its nave, or the nave is the name applied to the central portion of a church, so the human navel is a close approximation to the central point on the anterior abdominal wall. The exact location varies considerably, being relatively low in early childhood, and still lower with great corpulency, but is normally situated just above the level of the iliac crests, or opposite the disc between the third and fourth lumbar vertebrae. A third synonym, derived from the Greek,

The Omphalos

omphalos (retained as omphalocele, umbilical hernia; omphalic duct; omphalitis, etc.) likewise means a central object, and was the name of a stone located in the temple of Apollo at Delphi, supposedly marking the exact center of the earth.

Umbilicus and the Portal Circulation

For purposes of description the functioning structures at the umbilicus might be termed its "live" parts and those which are purely vestigeal, its "dead" parts. Perhaps the most important of the former are the veins which connect the umbilical region and the portal circulation. These travel

from the navel along the round ligament of the liver to empty into the left branch of the portal vein as it crosses the umbilical fossa. Umbilical infections may thus drain into the portal

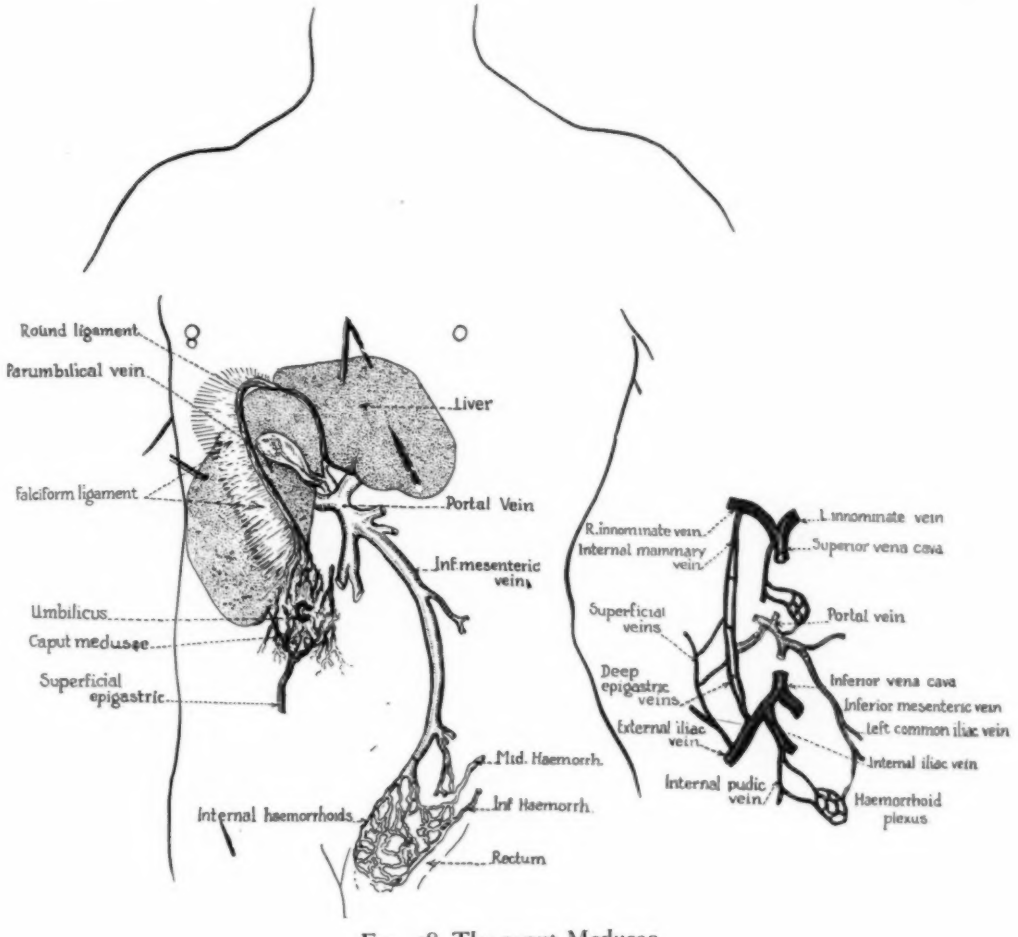

FIG. 38. The caput Medusae.

circulation to cause a secondary pylephlebitis (*pyle*, a gate, phlebitis, inflammation of portal venous system). Again, in cases of portal obstruction from diseases of the liver, back pressure often develops within these veins, causing congestion about the umbilicus. If the obstruction is complete, blood from the portal veins distal to the obstruction may actually flow out through the umbilical veins to reach the systemic circula-

tion through an anastomosis about the navel with the superficial epigastric veins. This gives rise to the phenomenon known clinically as the "caput Medusae" (Fig. 38), so called because of the presence of bluish, radially distributed, snake-like periumbilical veins (Medusa, a mythological character whose hair was transformed into serpents).*

Caput Medusae

"Live Structures of the Navel"

Concerning the other "live" structures of the navel: the nerves are terminal filaments of the anterior branches of the tenth thoracic trunks, interosculating with filaments from the ninth immediately above and the eleventh immediately below; the lymph glands are two, sometimes three in number, lying in the perperitoneal fat, one below and one or two just above the navel, the lower gland draining through lymph vessels to the external iliac glands, and the upper set draining the upper portion of the umbilicus to empty, by efferent vessels, into the inferior anterior mediastinal glands; the arterial supply is chiefly from the superior and inferior epigastric arteries, the former coming from the subclavian artery by way of the internal mammary artery and the latter from the external iliac artery, while both anastomose freely with adjacent branches of the intercostal arteries. The veins, in addition to the ones accompanying the round ligament, follow the arteries and thus ultimately drain both to the inferior and superior venae cavae. Many significant facts regarding these anatomical details are subsequently considered. This brief review merely serves to further the ease with which these essential minute points may be stored in the memory.

Vestigeal Structures at the Umbilicus

The umbilicus is connected to the bladder by means of a median umbilical ligament (Fig. 39). This is a remnant of the urachus (Greek word for urine) which is that portion of the allantois lying within the body of the fetus. (The allantois, from Gr. sausage + appearance, is a fetal membrane which enters, internally, into the formation of the bladder, and externally into the formation of the umbilical cord and

* Further consideration is given to the portal and "caval" collateral veins in the sections dealing with ascites and intraabdominal pressures.

placenta). The point of attachment to the bladder of this median ligament is at the bladder vertex. Rarely the urachus fails to close completely, forming a second opening between

Patent Urachus

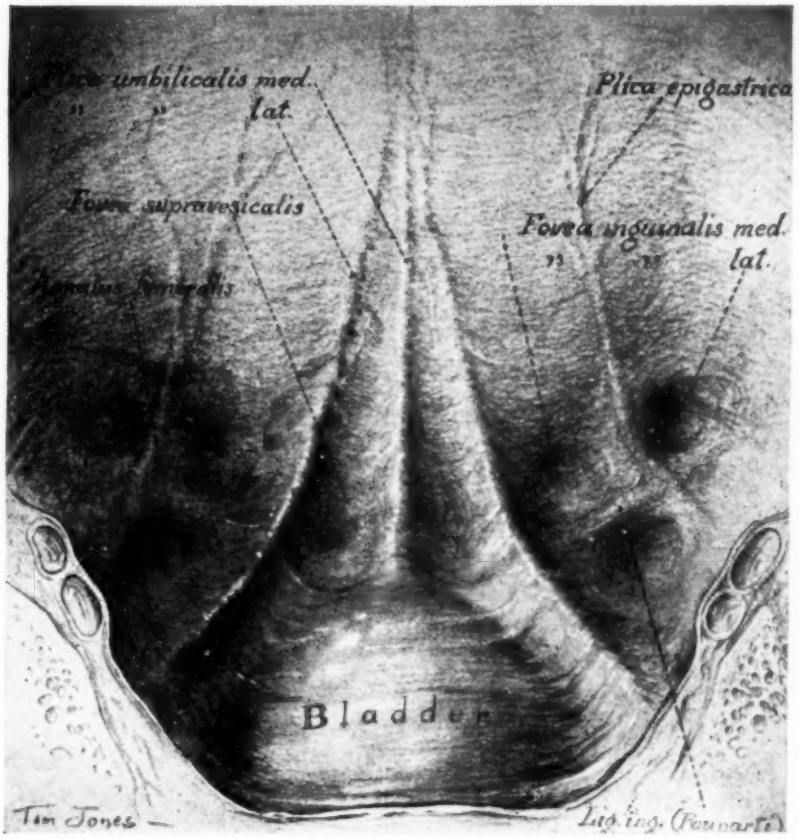

FIG. 39A. Ligaments of the umbilicus.

The median umbilical ligament represents a remnant of the urachus and connects with the bladder vertex. The lateral umbilical ligaments represent the obliterated umbilical arteries and pass to the hypogastric arteries. Note the peritoneal folds or plicae over the ligaments and the peritoneal fossae between the ligaments. (From Hertzler's The Peritoneum, Mosby.)

the bladder and the body surface, and causing a discharge of urine or cellular debris from the navel.

To the side of the median ligament run the two lateral umbilical ligaments. These lie beneath the peritoneum,

Significance of the Navel Connections with Vascular Trunks

(plicae lateralis). They pass over the pelvic brim to join the hypogastric arteries (Fig. 39B) (dextra and sinistra). These stout fibrous cords represent the obliterated umbilical arteries.

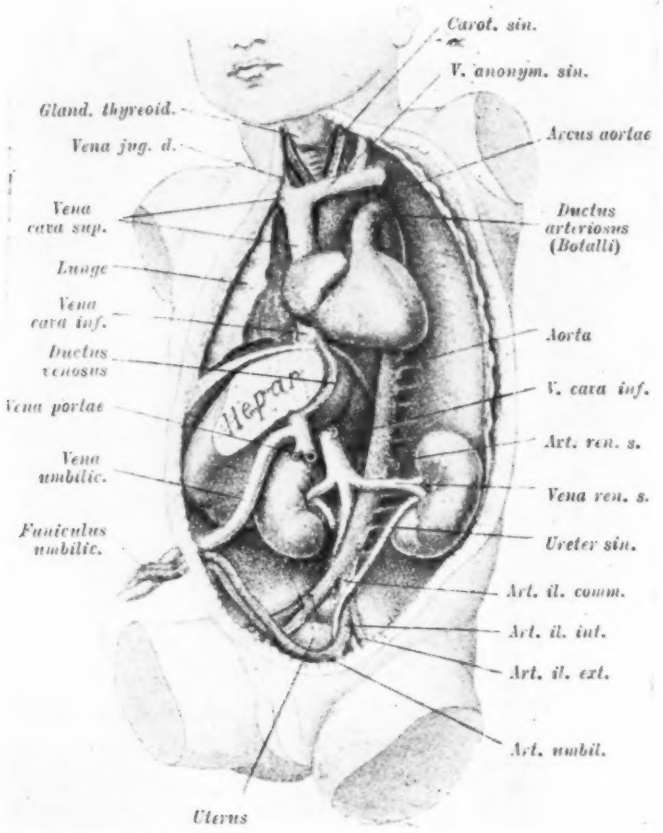

FIG. 39B. Umbilical vessels of the fetus. (From Gegenbaur.)

Their proximal portion, however, is not entirely obliterated, and enough remains patent to give origin to the superior vesical arteries. The chief significance to the surgeon of these lateral ligaments is that they explain the infraumbilical plicae in the peritoneum and that they serve as guides or points of direction. They may prove especially valuable to the surgeon when he is operating in the pelvis where extensive inflammation or neoplastic infiltration has rendered the field obscure. The round ligament of the liver is a fibrous cord derived from

the obliterated left unbilical vein. It travels from the navel to the left branch of the portal vein within the folds of the falciform ligament (described with the liver). Thus in carrying a midline incison past the umbilicus it is necessary to cut to the left of this structure in order to avoid cutting the round ligament. Upon the other hand, the surgeon may intentionally cut the round ligament in order to facilitate rotation of the liver around its transverse axis when unusual difficulty has been experienced in exposing the cystic and common bile ducts. In such instances the ligament is to be repaired before the abdomen is closed.

Rotation of Liver

From this summary it is seen that in the fetus three vessels pass through the umbilicus, the vein travelling directly upward and the two arteries travelling obliquely downward within the abdominal cavity (Fig. 39B). One remaining fibrous cord from an obliterated vessel is inconstantly present at the umbilicus, namely a band passing from the superior mesenteric artery, over the intestinal wall to the navel and representing an old means of nourishing; the primitive yolk sac.[60] (The origin and significance of this cord may be read in the original words of Meckel in the section dealing with eponyms, p. 128.) Such a free band, when present, passing from gut wall to umbilicus, may be the cause of an internal hernia, or band obstruction of the bowel.

The most common connection between umbilicus and enteral canal (Meckel's diverticulum) is discussed in a review of the intestinal tract (Fig. 40.). When present (2 per cent of cases) and patent (exceedingly rare) this may cause a discharge of intestinal content through the umbilicus. A rudiment of the diverticulum of Meckel may also account for deep entodermal neoplasms in the midline below the umbilicus. In addition this rudiment may give rise to many varieties of internal hernias, strangulations, or even autoanastomoses of the bowel (see Treves[61]).

Meckel's Diverticulum

The umbilicus is a final point of closure in the abdominal wall and within its fibrous ring, which is derived from the

Umbilical Hernias

linea alba, the peritoneum, fascia and skin are closely adherent, while muscle is entirely absent. During development the opening of the umbilical region is of huge size, at one time

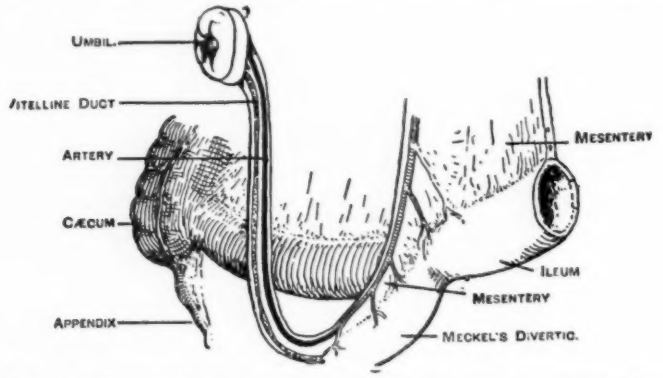

FIG. 40. Meckel's diverticulum, the remains of the vitello-intestinal duct, and of the artery to the yolk-sac. (From Treves.)

being equal to one-fourth to one-third the entire length of the embryo. At the sixth week of intrauterine life the navel remains large, is funnel shaped and normally contains a loop of bowel to the apex of which is attached the omphaloenteric duct (duct of yolk sac). Because of these facts hernias at this point might reasonably be expected with higher incidence than is actually found clinically. In rare instances the loop of gut fails to return to the abdomen proper and cases are recorded in which the accoucheur has severed bowel when cutting the cord.[62] Minor weaknesses of the navel, often observed at birth, tend to close spontaneously as the umbilicus is drawn backward and downward by its ligaments for the body wall continues to grow while the ligaments degenerate from the time when the umbilical cord is ligated and severed. Permanent umbilical weakness may give rise to hernias which vary in size from minute openings admitting but the tip of the little finger to huge masses containing large amounts of omentum, transverse colon, stomach, small bowel, etc. Coughing, straining and lifting, blowing the nose, and performing any act which increases the general pressure within the abdomen tends to aggravate the symptoms and increase the

degree of herniation. The increased size of the abdominal and peritoneal cavities caused by larger hernias leads to hypertrophy of the structures occupying the sac, and to an

FIG. 41. Side view of a case of umbilical hernia. (From Eisendrath's Surgical Diagnosis, Saunders.)

increase in the total amount of intra-abdominal fat (Fig. 41). So great is this increase in substance that the content of the large hernias is often reduced only with the greatest of difficulty and the high mortality following repair of such umbilical masses is thought to be intimately associated with the increased crowding and pressure within the abdomen following closure of the wall.[63] (See Intra-abdominal Pressure). So close is the adherence of skin and peritoneum over umbilical hernias

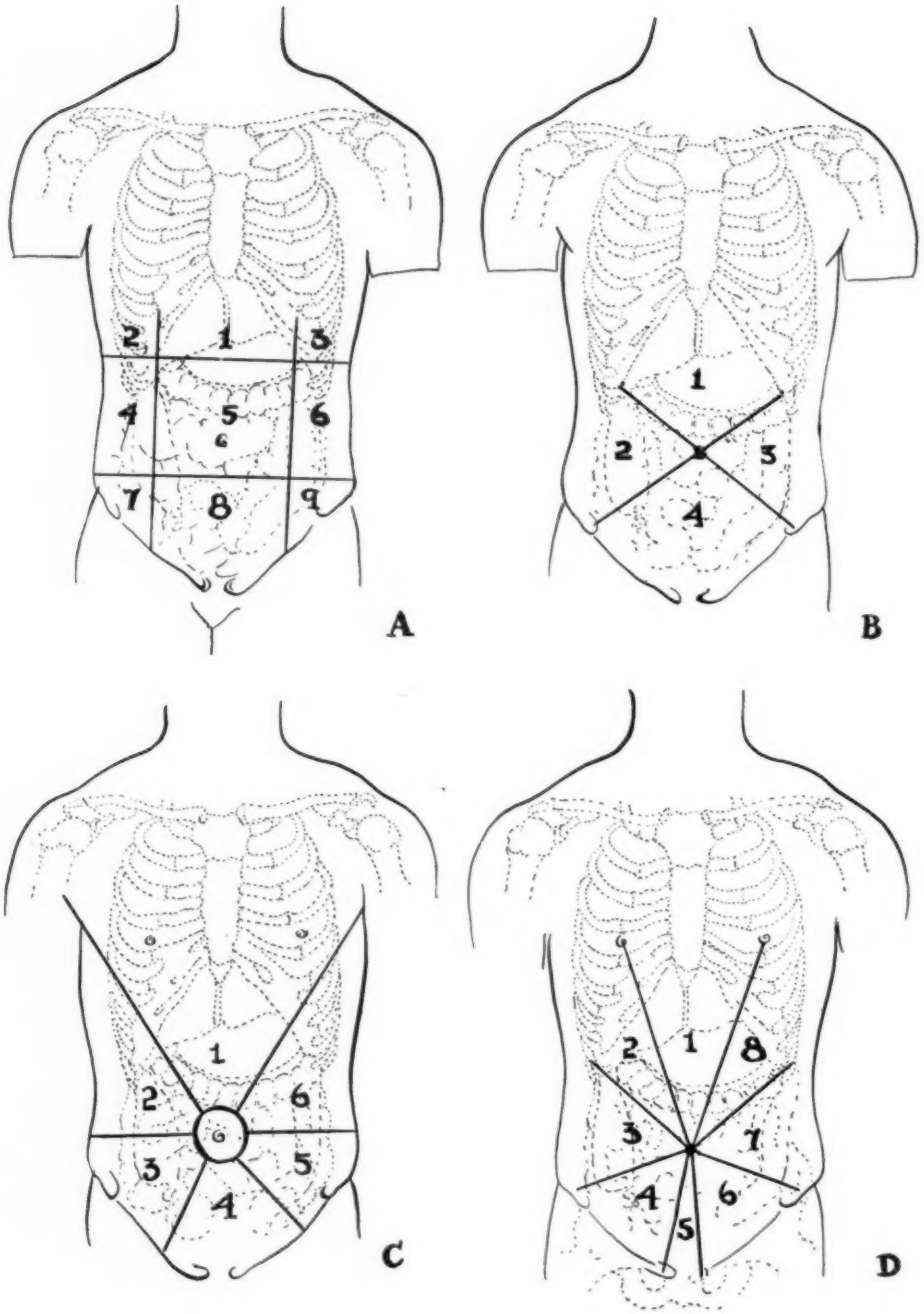

FIG. 42. Various suggested abdominal topographical markings.
A, After Addison. B, After Mayo-Robson. C, After Anders. D, After Hertzler.

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that the sac is almost always opened with the skin incision unless this be carefully made at one side of the mass. The danger of thus accidentally opening peritoneum is obvious.

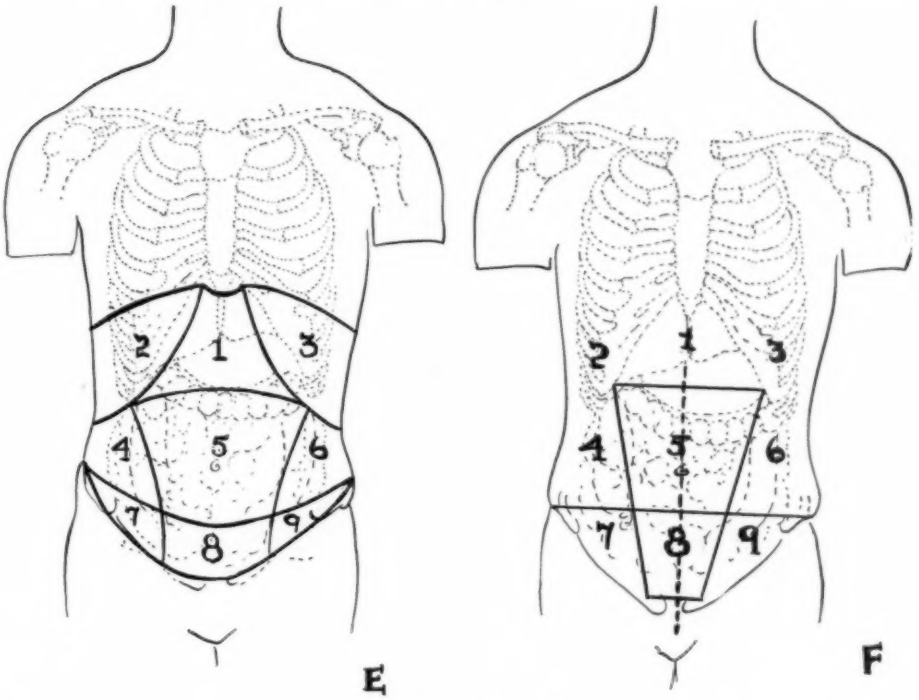


FIG. 42. (*Continued.*)
E, After B. N. A. System. F, After Barker.

5. The Vessels and Nerves of the Abdominal Walls. These will be dealt with in special chapters.

D. ABDOMINAL TOPOGRAPHY

Problems in Abdominal Topography

The object of abdominal topography (Gr. *topos*, place, + *graphe*, a description) is to describe intra-abdominal structures in relation to definite and limited areas on the surface. The exact attainment of this objective is by no means easy. Organs are dealt with which are movable. Tumors and other abnormalities must be described which adhere to no fixed limits. Even the surface on which the measurements must be taken is itself subject to considerable individual and postural

variation. To meet this situation many systems of topographical markings have been advocated. A few of these are illustrated in accompanying figures (Fig. 42). It would, indeed, prove difficult to conceive of any system not already advocated and the many claims and counterclaims relative to the various methods have led to much confusion. A great array of points, lines, circles, triangles, squares, rhomboids, and other figures have been suggested for the surface map, and topography has, in many instances, degenerated from the original high aim of marking upon the surface the location of organs beneath into an attempt to force these organs beneath into imaginary surface compartments, which fail to describe them properly, but prove orderly and convenient to the particular topographical system. The difficulties encountered in attempting to adhere to any single fixed "system" are such that the practical surgeon seems to require some more flexible method for taking his surface measurements and recording his topographical descriptions.

The Nine Abdominal Zones

The abdominal wall, by general acceptance, is divided into nine zones:[64] an epigastric, an umbilical, and a hypogastric; a right and a left hypochondriac; a right and a left lumbar; and a right and a left inguinal (Fig. 43). Two transverse and two vertical lines are utilized in bounding these zones. The horizontal lines usually employed are: a subcostal line, passing beneath the lower border of the tenth costal cartilages; and an intertubercular line, determined by the iliac tubercles, which mark the highest point of the iliac crests, and are easily found about 2 inches posterior to the anterior superior iliac spines. The two perpendicular lines (lateral vertical lines) pass upward from points on Poupart's ligaments midway between the symphysis pubis and the anterior superior iliac spines, and are parallel with the median plane of the body.

The Transverse Planes

Other transverse planes which have been suggested are illustrated in the accompanying figures (Figs. 43 and 44):

Xiphosternal or xiphoensiform plane

Midepigastric or transpyloric plane

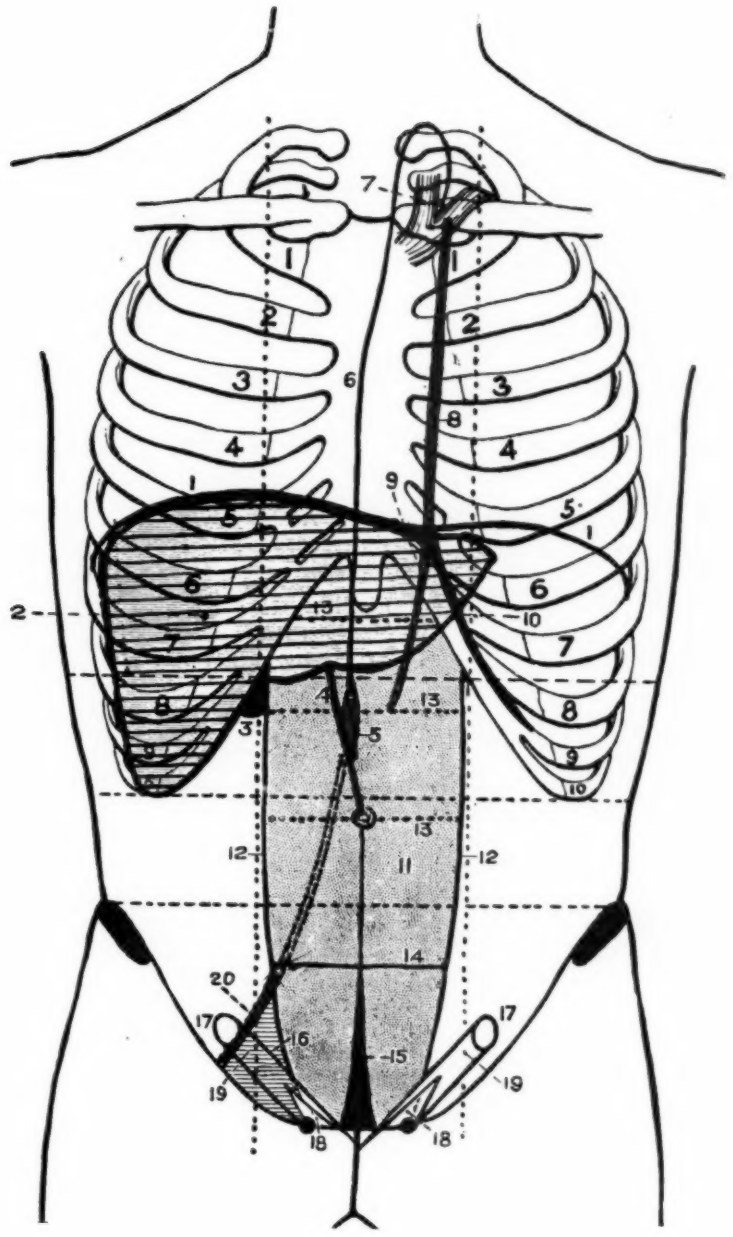


FIG. 43.

1. Diaphragm. 2, Liver. 3, Gall bladder. 4, Ligamentum teres. 5, Receptaculum chyli. 6, Thoracic duct. 7, Venous termination of the duct. 8, Internal mammary artery. 9, Superior epigastric artery. 10, Musculophrenic artery. 11, Rectus abdominis muscle. 12, Linæ semilunares. 13, Linæ transversæ. 14, Semilunar fold of Douglas. 15, Urachus. 16, Hesselbach's triangle. 17, Internal abdominal ring. 18, External abdominal ring. 19, Inguinal canal. 20, Deep epigastric artery. (From Rawling's Landmarks and Surface Markings of the Human Body, Hoeber.)

Subcostal plane
Central abdominal plane
Umbilical or navel plane

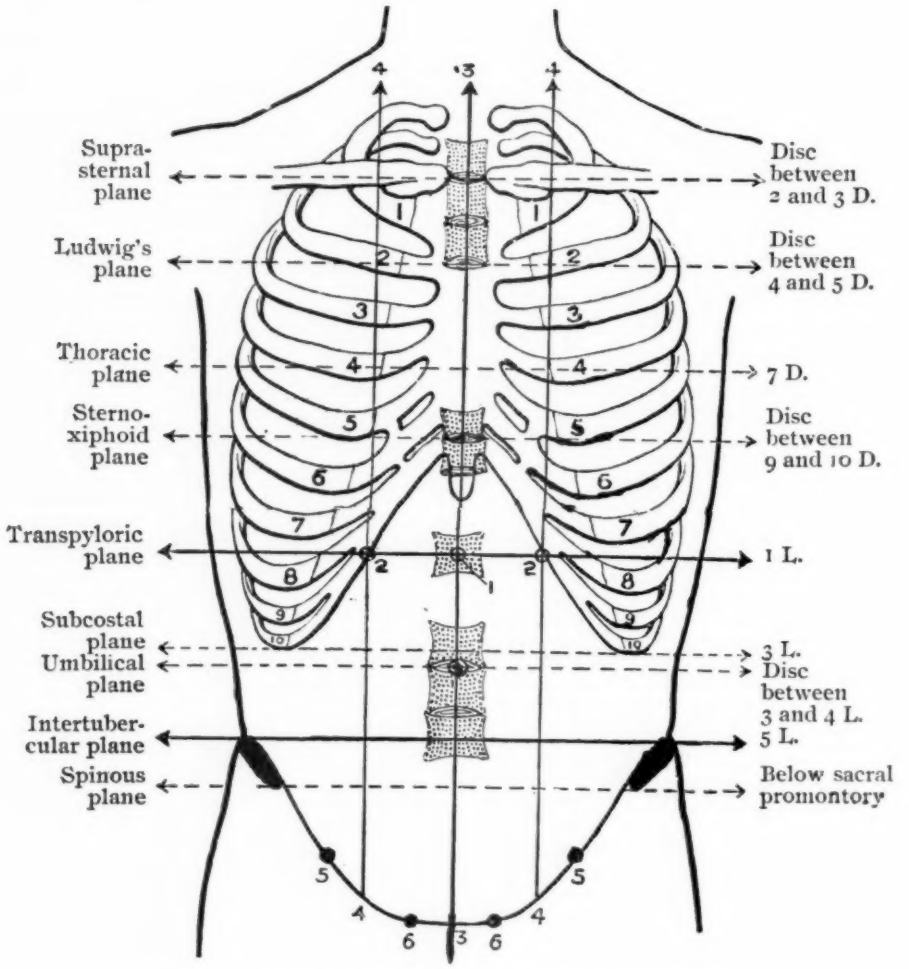


FIG. 44. Chief topographical landmarks of the trunks.

1, Central point. 2, Lateral central or paracentral point. 3, Median vertical plane. 4-Lateral vertical plane. 5, Mid-Poupart point. 6, Pubic spines. (From Rawling's Landmark's and Surface Markings of the Human Body, Hoeber.)

Intertubercular plane
Interspinous plane
Midhypogastric plane and
Mid-Poupart plane.

Addison,[65] after taking careful measurements upon forty bodies, was willing to recognize as constant only five of the many surface landmarks of the anterior body wall. These are: (1) The suprasternal notch; (2) upper border of pubes (the symphysis); (3) right anterior superior spine of the ilium; (4) left anterior superior spine of ilium, and (5) the midpoint of the midline of the body. Addison pointed out that planes depending upon points along the costal margins are unreliable and inconstant in position since the thoracic cage is suspended from the spine and is itself variable in location, i.e., that the subcostal plane might fall so low as to coincide with the umbilical or even with the intertubercular plane. He also noted that existing topographical systems failed to include any plane between the levels of the subcostal and the xiphosternal planes, an area of about 6 inches which contained all of the solid organs and many other important structures of the abdomen. By measurements he found that a plane taken at right angles to the midpoint of the trunk was remarkably constant and valuable. This plane has become known as the midepigastric plane, the line of Addison, or the transpyloric plane, and lies opposite the lower border of the first lumbar vertebra. It is determined by taking the midpoint between the suprasternal notch and the symphysis pubis, or again, that midway between the xiphosternal point and the umbilicus. Corresponding as it does with the level of the first lumbar vertebra, Addison's line marks, roughly, the line of dorsal attachment of the transverse mesocolon which separates the abdominal cavity into its two great divisions, the supracolic and the infracolic. This line marks the transverse bisection of the pylorus (normal) when the stomach is at rest, and is in relation not only with the root of the transverse mesocolon, but also with the kidneys, liver, gall bladder, duodenum, stomach, pancreas and spleen. Thus fixed planes (Fig. 45) overlie the first, third, and fifth lumbar vertebrae; uppermost, the midepigastric plane (Addison's line); lowermost, the intertubercular plane; and midway between these, the central abdominal plane which overlies the third vertebral body.

Addison's Line or the Midepigastric Plane

Among the abdominal "points" (Fig. 46) which have been recorded as being of topographical or clinical value are the following:

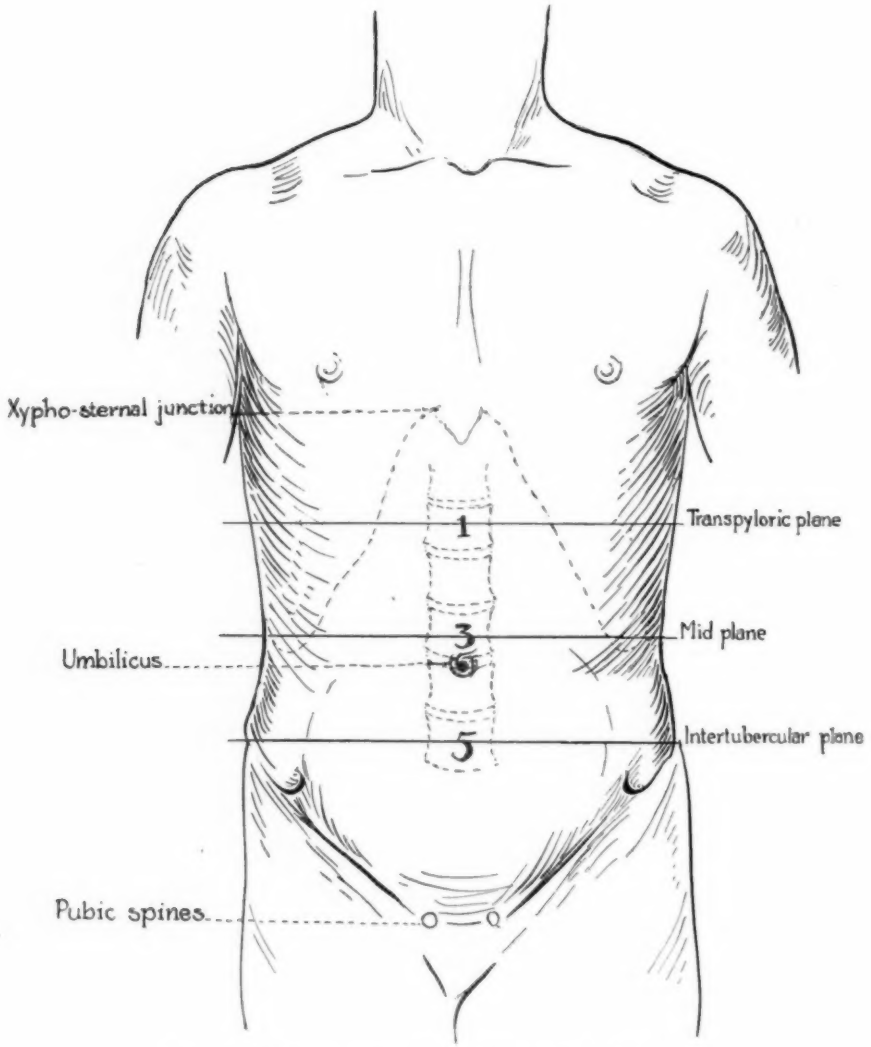


FIG. 45. "Fixed" transverse planes of the abdomen.

Umbilicus (definitive name; location discussed).
Addison's point (location already given).
Midepigastric point (same as Addison's point).

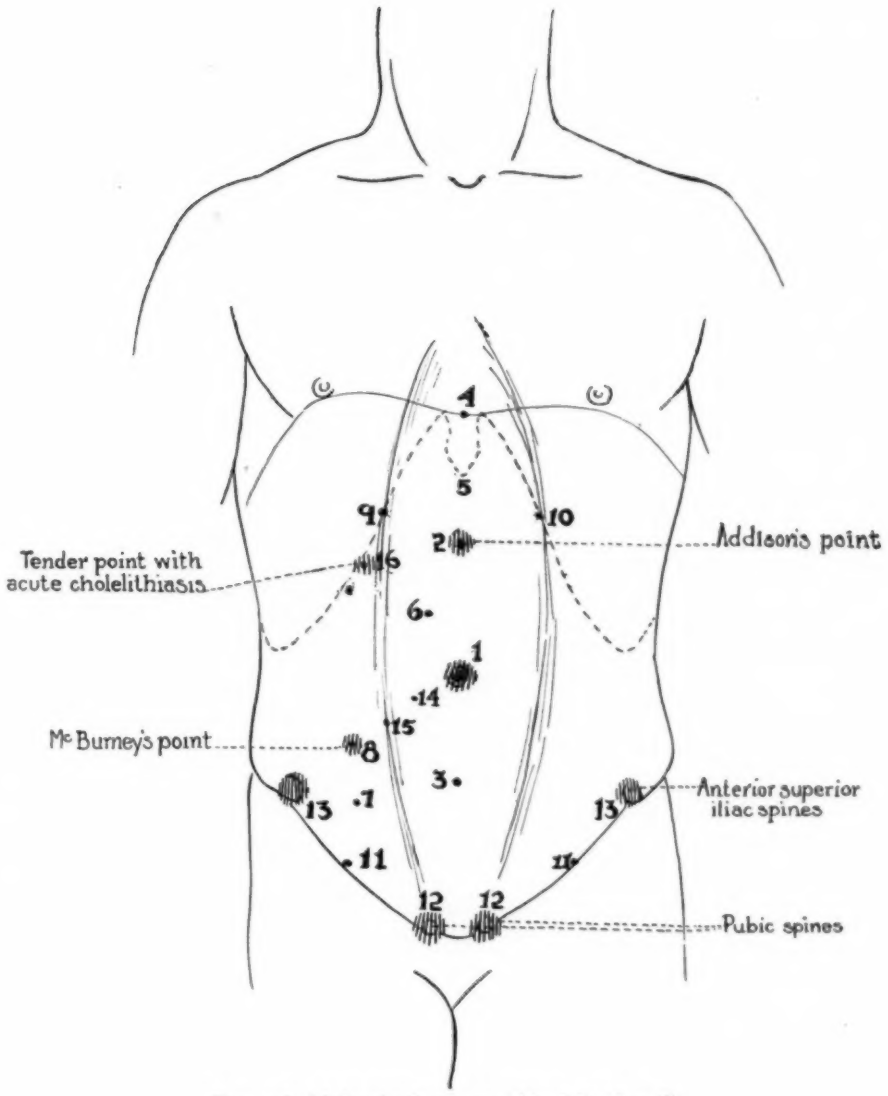


FIG. 46. Abdominal topographical "points."

1, Umbilicus. 2, Addison's or midepigastric point. 3, Midhypogastric point. 4, Sternoxiphoid point. 5, Tip of ensiform cartilage. 6, Robson's point. 7, Lanz' point. 8, McBurney's point. 9, Right costorectal point. 10, Left costorectal point. 11, Mid-Poupart point. 12, Pubic spine. 13, Anterior superior iliac spine. 14, Morris's point. 15, Munro's point. 16, Tender point with acute cholelithiasis.

"Abdominal Points"

Midhypogastric point, located halfway between the umbilicus and the symphysis pubis in the linea alba (spinal equivalent is variable).

Sternoxiphoid point (definitive name). This lies as a rule on a level with the disc between the ninth and tenth dorsal vertebrae.

Sternoensiform point (same as sternoxiphoid point).

The right costorectal point, located at the junction of the right linea semilunaris with the costal margin. This anatomical point is supposed to mark approximately the location of the fundus of the gall bladder.

The left costorectal point located at the junction of the left linea semilunaris with the costal margin. This marks approximately the spot where the greater curvature of the stomach passes beneath the costal margin.

McBurney's Point

McBurney's point, described by McBurney[66] as "located between (in different individuals) 1½ and 2 inches (3 to 5 cm.) of the anterior superior iliac spine on a straight line drawn from that process to the umbilicus." "In every case [of acute appendicitis]," wrote McBurney, "the seat of greatest pain, determined by the pressure of one finger, has been exactly at this point." The point represents the spot at which the terminal filaments of the eleventh thoracic nerve come to the surface as in a whorl (Murphy).

A diagnostic point for acute diseases of the gall bladder (Fig. 47). This is located within 1 inch (different directions with different individuals) of the junction of the midepigastric line with the right costal margin.[67] This point marks the site at which the anterior branch of the ninth thoracic nerve comes to the surface in a whorl.

Robson's point, located at the inner point of trisection of a line joining the umbilicus and right nipple. Described by Mayo Robson[68] as "just above and to the right of the umbilicus, where tenderness on pressure exists with diseases of the pancreas."

Munro's point, at the junction of the spinoumbilical line and the right linea semilunaris.[69] Originally advanced as the

most constant site of the ilioceceal valve. It is still retained as a topographical point.

Morris' point, located within 2 inches of the umbilicus

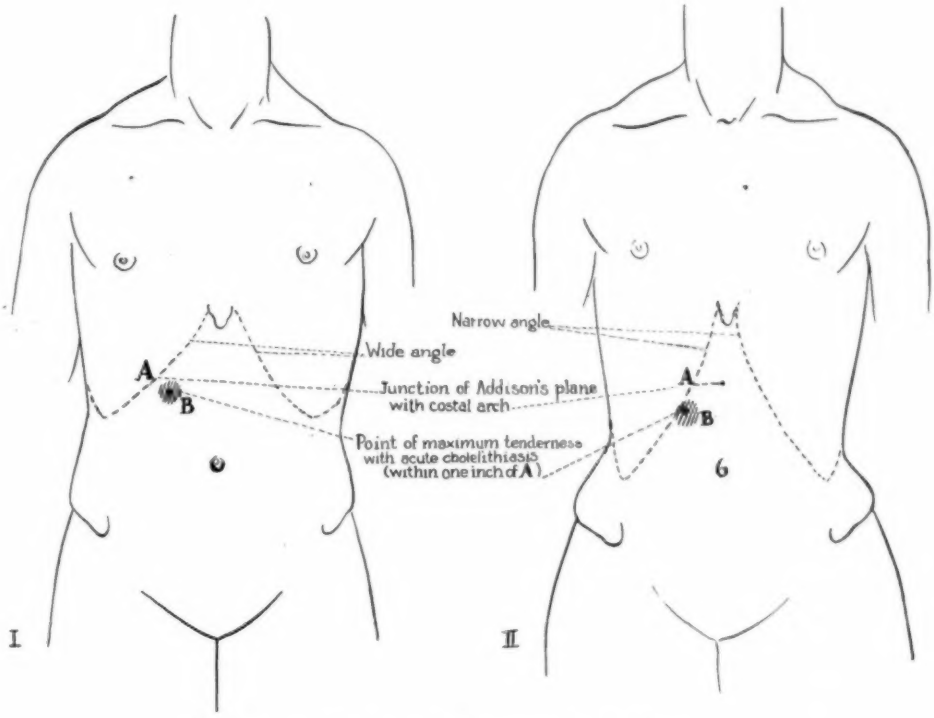


FIG. 47. Tender point for acute cholelithiasis.

I. With normal or barrel chest.

II. With visceroptotic chest.

on the right spinoumbilical line. Believed by Morris[70] to be a site of tenderness with chronic appendicitis, and present when none exists at the site noted with acute appendicitis (i.e., McBurney's point). Much has been said both for and against the value of the sign in the sense proposed by Morris.

Lanz' point. This is located at the junction of the right linea semilunaris with the interspinous line, and was proposed as a marking for the usual location of the appendix.[71] While this site possesses no clinical and no distinct anatomical significance, it serves as a topographical landmark.

The value of the points of Munro, Morris and Lanz has been questioned, as has the wisdom in retaining these eponyms. On the other hand, McBurney's point has proved of "inestimable value in the diagnosis of acute appendicitis," and its clinical worth is not in the least modified by the proximity of other surface markings. The analagous point (already described) marking the site of tenderness with acute diseases of the gall bladder seems equally constant and valuable.

Abdominal surgeons make use of several triangles located upon the surface of the anterior, lateral and posterior abdominal wall, and upon the thigh. The list includes:

Hesselbach's triangle: base, Poupart's ligament; outer boundary, the deep epigastric artery; inner boundary, linea semilunaris of the same side. This triangle is the site through which direct inguinal hernias protrude.

Surface Triangles

Scarpa's triangle (femoral or subinguinal triangle): base, Poupart's ligament; inner boundary, adductor longus; outer boundary, the sartorius muscle. It is through the triangle of Scarpa that femoral hernias protrude.

Petit's triangle (lumbar triangle or trigone): (Already bounded, see Drainage through the Hepatorenal Pouch).

Lumbocostoabdominal triangle: Bounded above, by the last rib; medially, by the lateral border of the sacrospinalis muscle; laterally, by the posterior fibers of the internal oblique; floor, formed by the transversus abdominis; roofed by the serratus posterior inferior muscle. This forms a second point of weakness in the posterolateral abdominal wall.

Topographical triangles of Hertzler: This author has described[72] a series of lines radiating from the umbilicus to the following points on each side: the pubic spine, the iliac tubercle, the tip of the eleventh rib, and the nipple, dividing the surface into eight triangles.

Triangles of cutaneous hyperesthesia. (These triangles represent a method for the practical use in diagnosis of cutaneous hyperesthesia as initiated by certain visceral disorders.) (See chapter on Visceral Neurology.)

The Appendiceal; Ureteral and Biliary Triangles

1. *The triangle of renal colic:* base, the inner half of Poupart's ligament; outer boundary, a line parallel to the sartorius muscle, extending from the right mid-Poupart point to the inner margin of the thigh; inner boundary, the inner margin of the thigh from the apex of the triangle to the right pubic spine.[76]

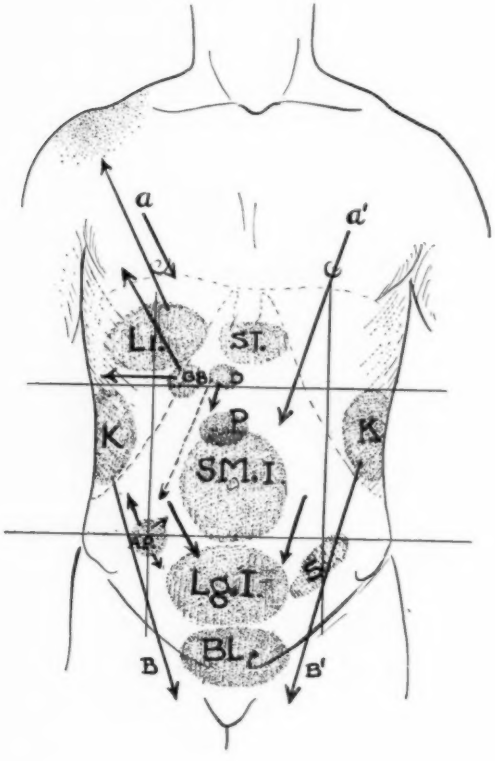
2. *The triangle of biliary colic.* Base, the linea alba from the sternoxiphoid point to the umbilicus; upper boundary, a line from the sternoxiphoid point to the junction of the mid-epigastric plane (Addison's line), with the right midaxillary line; lower boundary, a line from this point (junction of Addison's line and the midaxillary line) to the umbilicus.[73]

3. *The triangle of acute appendicitis.* Base, a line from the umbilicus to the right pubic spine; lower boundary, a line from the pubic spine to the right iliac tubercle; upper boundary, a line from the right iliac tubercle to the umbilicus.[74]

A Flexible System of Topography

The surgeon in recording the exact location of tumors and other abnormalities may exercise great freedom and latitude as to topographical method. He is able to accept the advantages of any or all of the fixed systems based upon the authority of individual anatomists, but at the same time need not be hampered by the limitations of any single system. This is true because the surgeon is not seeking, as is the anatomist, surface lines or areas bearing precise relationships to underlying structures constant in location, but is dealing with masses which may appear at any point whatsoever. The common denominator of all topographical systems is their surface landmarks, and by going back to these, the surgeon attains the flexibility which his work demands. He is able at will to strike lines, mark out circles, subtend angles, and create planes, so long as he works from clearly understood landmarks. Moreover, in dealing repeatedly with an individual patient, whose abdominal landmarks will remain approximately the same at different examinations, the surgeon is not limited to the relatively few points or planes which are so exactly fixed as to be universally applicable, hence

serviceable for the anatomist. In this flexible method any landmark may be utilized. In adopting the method, certain useful rules may be stated:



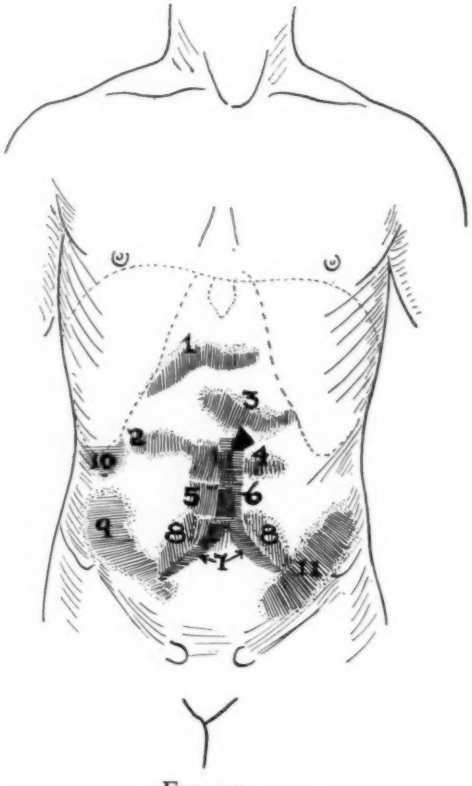


FIG. 48. FIG. 49.

FIG. 48. Common sites of pain and pain-radiation with acute abdominal disorders.

St, Stomach. D, Duodenum. P, Pancreas. Sm. I, Small intestine. Lg. I., Large intestine. Bl., Bladder. K., Kidney and ureter. S, Sigmoid colon. G.B., Gall bladder. A-A', Pain of thoracic disease referred to abdomen. B-B', Pain of uteral colic referred to thigh and genitals.

FIG. 49. Abdominal organs most often felt during abdominal examination. (Modified from Elsberg.)

1, Margin of liver. 2, Transverse colon. 3, Greater curvature of stomach. 4, Transverse colon. 5, Lumbar vertebrae. 6, Aorta. 7, Iliac arteries (common). 8, Psoos major muscle. 9, Coecum and ascending colon. 10, Lower pole of right kidney. 11, Sigmoid and descending colon.

To create a topographical point: (a) Create two lines which meet at this point (example, the rectocostal point is located at the junction of the outer border of the right rectus sheath

Rules and Examples for the Use of the Flexible Method

with the costal margin. (b) Pass any line which can be determined by two landmarks through the point and measure along this line to the desired point from either landmark (example, McBurney's point is located from 1½ to 2 inches along the spinoumbilical line).

To create a topographical line: Take the shortest distance between two topographical points.

To create a topographical circle: Take an imaginary circle having a stated radius from any fixed topographical point.

To create a topographical triangle: Join three landmarks, so selected that the boundaries of the triangle (lines joining the landmarks) roughly bound the abnormality in question.

To enclose any topographical figure: Consecutively join any set of landmarks, so selected that the joining lines enclose the abnormality to be described.

Examples of application of flexible method:

1. "This globular, cystic mass lies within a circle having a 2 inch radius and a center 1 inch to the right of the umbilicus" (case proved to be one of mesenteric cyst).

2. "This sausage-shaped mass is 2 inches wide and extends horizontally, lateral to the right mid-Poupart line, from a point 1 inch below the level of the anterior superior iliac spine, to end indefinitely at about 1 inch below the right costal margin" (this case proved to be one of iliocecal tuberculosis).

3. "This pear-shaped mass extends downward for 2 ½ inches from the right rectocostal point. It can be moved to the right for 2 inches and to the left as far as the midline, describing an arc the concavity of which is directed upward, the obvious point of attachment of the mass being within the right hypochrondrium" (case proved to be one of hydrops of the gall bladder).

The accompanying clinical illustrations (Figs. 48, 49) are self-explanatory. They demonstrate with reference to topography, (a) the normal intra-abdominal structures which may most often be palpated through the anterior abdominal wall (Fig. 48); and (b) the usual sites and radiations of certain common abdominal pains (Fig. 49).

EPONYM

CHARLES McBURNEY

Eponym: "McBurney's Point."

Nativity: Roxbury, Massachusetts.

Birth and Death: Born February 17, 1845. Died November 7, 1913.

Connections: 1873. Assistant demonstrator of anatomy at the College of Physicians and Surgeons.

1874. Attending surgeon, St. Luke's Hospital.

1880. Assistant surgeon, Bellevue Hospital.

1882. Lecturer on operative surgery, College of Physicians and Surgeons.

1886. Consulting surgeon to Presbyterian Hospital; New York Hospital; Hospital for the Ruptured and Crippled.

1888. Given entire surgical service of Roosevelt Hospital. (Held position for twelve years.)

1889. Professor of surgery, College of Physicians and Surgeons.

1892–1895. Vice-president, New York Academy of Medicine. Honorary member of the Royal College of Surgeons (England). Honorary Member of College of Physicians and Surgeons (Phila.).

Education: Early education; private schools of Boston.

Bachelor of Arts, Harvard, 1866.

Medical degree, College of Physicians and Surgeons, 1870.

S' gical internship, Bellevue Hospital, New York City.

Postgraduate study (Europe) subsequent two years.

Eponym Source: "Experience with Early Operative Interference in Cases of Disease of the Vermiform Appendix," *New York M. J.*, 50: 676, 1889.

"Discussion on Appendicitis; Indications for Early Laparotomy." *Tr. M. Soc. N. Y.*, 1891, p. 208.

Other Writings: McBurney also wrote concerning the transduodenal method for removing stones from the common bile duct; about "a small transperitoneal incision for the purpose of compression of the common iliac artery by the fingers of an assistant during disarticulation of the hip joint;" contributed to Dennis' System of Surgery, also to the International Textbook of Surgery. He introduced McBurney's hooks for skin grafting and McBurney's tractor for the reduction of fractures at the shoulder joint. It was in 1894 that he proposed the so-called McBurney incision for appendectomy.

Discussion of Eponym: McBurney stated that his point indicated the most common site of the base of the appendix. This started a wave of anatomical investigation as to the accuracy of the statement. Notable among the opponents of McBurney were Munro and Lanz. The former found the base of the appendix most often beneath the junction of the spino-umbilical line with the right linea semilunaris (Munro's point);[1] the latter stated that the base of the appendix most often was to be found at the junction of the outer and midthirds of the interspinous line (Lanz' point).[2]

Treves was particularly outspoken as to the variation in the position of the appendix and gave little recognition to the value of the single point of McBurney.[3]

Murphy, while recognizing the error in assuming that McBurney's point overlay the site of the base of the appendix was still emphatic as to the clinical value of the point-tenderness sign and extensively reviewed possible explanations as to the constancy of the diagnostic evidence.[4] Among suggested interpretations were, a, that the point was due to an excitation by pressure, of underlying sympathetic ganglia b, that it originated

TRANSACTIONS

OF THE

MEDICAL SOCIETY

OF THE

STATE OF NEW YORK,

FOR THE YEAR 1891.

PUBLISHED BY THE SOCIETY.
1891.

XVI. Discussion on Appendicitis: The Indications for Early Laparotomy.

By CHARLES McBURNEY, M.D.,
NEW YORK.

The title of this paper is one which a very few years ago—not more than four—would have excited the surprise and even the condemnation of many surgical and medical practitioners. The very

I have found the *exact* locality where the greatest sensitiveness to pressure exists to be a valuable means of diagnosis, so that in every case of abdominal pain, not otherwise satisfactorily explained, I make a careful search for it. In the first hours of an attack of appendicitis, it is not enough to compress with the whole hand the region of the iliac fossa. Such pressure will often elicit no more complaint from the patient than pressure of a similar kind made at other parts of the abdomen. But if firm pressure is made with the finger-tip, and especially if the patient be made to cough while such pressure is being exerted, it is invariably easy to determine that the most sensitive point is a definite one in most cases. This point is very accurately in the adult from one and a half to two inches inside of the right anterior superior spinous process of the ilium on a line drawn to the umbilicus. In children it is, in proportion to their size, so much less distant from the spinous process. Occasionally this most sensitive spot will be found a half inch or so nearer the pubes, and sometimes this sensitive area will be larger than usual, but from the first hours of the disease, even up to the end of several days, this sign may be clearly made out in every case. No other acute disease presents this feature. The accuracy of this sign I have demonstrated in every case operated upon by me since I first made the observation. The point described corresponds very accurately in the living subject to the base of the appendix, and for this reason the sign is clearly defined, whether the appendix is long or short, or points up or down. Of course, in late stages of the disease this sign does not usually exist. My friend, Dr. Weir (*The Medical News*, March 1, 1890), commenting upon this observation of mine as to the exact spot of extremest sensitiveness on finger-tip pressure, does not agree with me as to its value, and says: "Furthermore, I have myself found on examination of 18 healthy persons by the above test of McBurney, that in 4 of them decided

FIG. 50A. Title page of the *Transactions of the Medical Society of the State of New York*, 1891, and the page on which McBurney's discussion of appendicitis appeared.

Continued from p. 124

from inflammed lymph nodes at this site, c, that the tenderness came from a lymphangitis originating from the appendix and spreading to this area. Murphy believed the real explanation to be that the point of McBurney represented a local area of distribution of cutaneous and subcutaneous nerves which were in reflex connection with afferent stimuli arising from the appendix; he held that the spot indicated by McBurney was that of maximum tenderness regardless of the position of the appendix itself and that the tenderness arose from pressure upon the structures of the body wall itself, not upon structures within the peritoneal cavity beneath.

Many incorrect statements as to the location of McBurney's point are to be found in current surgical textbooks and dictionaries. The most common misstatement is that the point lies half way between the right anterior superior iliac spine and the umbilicus.[5,6,7,8] It may also be read that the point is always 5 cm.; also 7 cm. from the iliac spine; that it corresponds to the outer margin of the rectus abdominis muscle on the spinoumbilical line, etc.

The fact seems generally to have been ignored that McBurney did not say there was one exact point of maximum tenderness applicable to all individuals but stated that the location of the point was at a variable distance along the spinoumbilical line (within two inches of the anterior superior iliac spine) i.e., while there is no single exact point for all individuals, for *each* individual there is such a single exact point and its location is between one-and-a-half and two inches of the right anterior superior iliac spine on the spino-umbilical line.

Points of Interest:

McBurney was a true sportsman being always fond of outdoor life; during his internship at Bellevue he rowed almost daily upon the East River in a single shell; he was an ardent devotee to golf; was an expert shot and an expert salmon fisherman.

McBurney was among the first to adopt, improve, and simplify aseptic methods such as sterilization of operating materials and instruments by means of the modern steam sterilizer and the use of sterilized gloves in operative work. His fame rests largely with his treatment of appendicitis by the operative method.

By a gift of William J. Sims (1892) the first model elaborate operating pavilion was established for McBurney at Roosevelt Hospital. "His workshop, the Sim's amphitheater of the Roosevelt Hospital was planned by him and built under his direction and was at the time one of the finest surgical amphitheaters in America and a Mecca for American as well as Foreign surgeons."

"He could not have been called a brilliant operator but his lack of hesitation founded on care with which he planned every operation and the thoroughness with which he completed each step before passing to the next resulted in a great saving of time and left the spectator with a profound impression that he had seen a master of art at work; bold, yet a great respector of tissues, the finished result of his operation left little to be desired" (Peck).

McBurney married Mary Willoughby Weston, Oct. 8, 1874. They had two sons and a daughter. Mrs. McBurney died in 1909.

Dr. McBurney was called to the bedside of President McKinley a few days before his (McKinley's) death.

Due to ill health McBurney retired in 1908 and died at the home of his sister in Brookline, Mass. of heart failure following a hunting trip in Maine (Nov. 7, 1913).

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THE NEW YORK MEDICAL JOURNAL, DECEMBER 21, 1889

Original Communications.

EXPERIENCE WITH EARLY OPERATIVE INTERFERENCE IN CASES OF DISEASE OF THE VERMIFORM APPENDIX.*

BY CHARLES McBURNEY, M. D.,
VISITING SURGEON TO THE ROOSEVELT HOSPITAL.

I VENTURE to introduce once more a subject that has been so ably treated by numerous writers, because I have for some time been devoting my attention in suitable cases to a particular line of treatment, and because I have been fortunate enough to have had recently a considerable number of cases of disease of the appendix under my care.

It is not my intention in this paper to attempt to present the subject of pericæcal inflammations in a systematic manner. That has already been done, and very recently, by a large number of writers. I have chosen rather to dwell upon some points in the pathology and treatment of these inflammations, which are beginning to be better understood and which especially interest us all. The fact that inflammatory affections of the vermiform appendix give rise to a considerable number of the so-called pericæcal inflammations is now accepted in every part of the medical and surgical world

This is, I believe, the first recorded case where an acutely inflamed unruptured appendix has been removed full of pus. Who can doubt what the result would have been in this particular case had the cyst ruptured, and the operation been delayed a few hours? Would not the opportunity for recovery have been lost had the advice so often and so recently given been followed—to delay operation until symptoms of spreading peritonitis appeared?

* Read before the New York Surgical Society, November 13, 1889.

The *exact* locality of the greatest sensitiveness to pressure has seemed to me to be usually one of importance. Whatever may be the position of the healthy appendix as found in the dead-house—and I am well aware that its position when uninflamed varies greatly—I have found in all of my operations that it lay, either thickened, shortened, or adherent, very close to its point of attachment to the cæcum. This, of course, must, in early stages of the disease, determine the seat of greatest pain on *pressure*. And I believe that in every case the seat of greatest pain, *determined by the pressure of one finger*, has been very exactly between an inch and a half and two inches from the anterior spinous process of the ilium on a straight line drawn from that process to the umbilicus. This may appear to be an affectation of accuracy, but, so far as my experience goes, the observation is correct.*

Before describing the steps of the operation, I refer again to the important aid to diagnosis of which I have already spoken—namely, the ascertaining, by the pressure of a single finger-tip, that the point of greatest tenderness is, in the average adult, almost exactly two inches from the anterior iliac spine, on a line drawn from this process through the umbilicus. Much greater tenderness at this point than at others, taken in connection with the history of the case and the other well-known signs, I look upon as almost pathognomonic of appendicitis. This point indicates the situation of the base of the appendix, where it arises from the cæcum, but does not by any means demonstrate, as one might conclude, that the chief point of disease is there. The abscess, or concretion, or cyst may be at quite a little distance, but the greatest pain, on pressure with one finger, will be felt at the point described.

* Since reading this paper I have carefully observed three other cases. In two the point of pain shown by pressure with one finger was two inches, and in the other an inch and seven eighths from the anterior spine.

FIG. 50B. Excerpts from McBurney's article in *The New York Medical Journal*.

SUPPLEMENT: A. J. S., n. s. Vol. VIII, No. 3, p. 731

EPONYM

JOHANN FRIEDRICH MECKEL

Eponym: Meckel's diverticulum. (Remains of the ompholoenteric duct.)

Nativity: Halle, Germany.

Birth; Death: Born Oct. 17, 1781. Died, Oct. 31, 1833.

Connections: Appointed professor of surgery at Halle but promptly exchanged this chair for that of professor of anatomy and physiology.

Education: Early education received under his paternal roof. Sent to Magdeburg where he attended the city school.

Studied medicine at Halle and at Göttingen.

Thesis at University of Halle, at the age of twenty-one, "De Conditionibus Cordix Abnormibus."

Received his doctor's degree at Halle in 1802.

Traveled in Italy, Germany, and France where he studied comparative anatomy. (Recalled from his first trip to Vienna by the death of his father 1803.)

Eponym Source: "Ueber die Divertikel am Darmkanal." *Arcb. f. Physiol.*, 9:421–453, 1809.

Biographie universelle; ancienne et moderne, 27:459.

Manual of Descriptive and Pathological Anatomy. English Ed. London, E. Henderson, 1838.

(Translated to English from the French by A. S. Doane.)

(Translated to French from the German by Jourdan & Breshet.)

(Original German edition was published in 1812.)

Other Writings: Abhandlungen aus der Menschlichen und Verglichender Anatomie und Physiologie. Halle, Hemmerde u. Schwetschke, 1806.

Handbuch der Menschlicken Anatomme Halle u. Berlin 1811.

Editor, Deutches Archiv. fur die Physiologie. Halle u. Berlin 1815–1823.

Editor, Archiv. fur Anatomie und Physiol. Leipzig 1826–1832.

Discussion of Eponym: Considerable confusion has arisen regarding credit for this eponym due to the fact that there were two anatomists, grandfather and grandson, with identical names. By many (Stedman,[1] Buck,[2] Buntz,[3] and others[4]) credit has been given to Johann Friedrich Meckel, the elder (1717–1774) but the writings of this anatomist fails to show that he studied or described the diverticulum in question.

The elder Meckel is rightly known for Meckel's ganglion (spheno-palatine); Meckel's cavity (space enclosing the Gasserian ganglion); Meckel's band (portion of anterior ligament binding the malleus to the wall of the tympanic) etc. He also wrote concerning hernias (Tractatus de Morbo Hernioso Congenito Singulari et Complicato Feliciter Curato. Berloini, F. Nicolai, 1772), but included no reference to diverticulum of the terminal ileum.

It was the grandson, Johann Freidrich Meckel, the younger, who wrote extensively concerning the omphalo-mesenteric duct and who distinguished the diverticulum arising from this duct from all other diverticuli of the enteric tract. The younger Meckel described the relation of the omphalo-mesenteric vessels to the diverticulum and the passage of vascular cords from the mesentery of the small bowel to the umbilicus. The diverticulum, however, had been previously described and in 1809 Meckel collected all recorded cases to that date (Ueber Diverticuli; see photostat). Among these few cases were two recorded by his father (Philipp Freidrich Theodor Meckel, 1753–1803) (Thamm de Genitalieum fex. Varietatibus. Halae, 1799. Pg. 27, see photostat).

The first reference by a Meckel, then, to a diverticulum of the terminal ilium seems to have been made by Philipp Freidrich Theodor Meckel but it was Johann Freidrich

Archiv für die Physiologie.

Neunten Bandes drittes Heft.

Ueber die Divertikel am Darmkanal, vom Prof. Meckel.

Gegen dieſe Gründe und Beyſpiele aber könnte man einwenden, daſs ſie nichts für den normalen Bau beweiſen, indem ſie von Miſsgeburten entlehnt ſeyen; allein dieſer Einwurf hebt ſich durch die Unterſuchung menſchlicher Embryonen ſehr leicht. Schon früher *) habe ich einen Fötus beſchrieben, bey dem aus dem Vereinigungswinkel des obern und untern Dünndarmſtückes ſich ein von den Nabelgefäſsen verſchiedenes, gelbliches Gefäſs in der Nabelſcheide fortbegab. Bey einem andern, noch frühern Fötus **), ſahe ich ein ähnliches Gefäſs von der Nabelblaſe aus durch den ganzen Nabelſtrang verlaufen. Kürzlich habe ich in derſelben Hinſicht noch einige Embryonen unterſucht, und bey ſpätern, ungefähr zehn Wochen alten, zwar den Darmkanal in den Unterleib zurückgetreten, jenen langen Kanal, ſo wie die Nabelblaſe ſelbſt, verſchwunden, aber dafür bey zwey Embryonen dieſes Alters, an der gewohnten Stelle, ungefähr einen Zoll über der Verbindung des Grimmdarms mit dem Krummdarme, auſser dem deutlichen Blinddarm ein wahres blindes Divertikel, das bey dem einen eine halbe, bey dem andern eine ganze Linie lang war, dort perpendikulär, hier ſchief auf dem Krummdarm ſtand, und nur halb ſo weit, als er ſelbſt war, angetroffen. In beiden waren zugleich die Gekrösnabelgefäſse als äuſserſt feine, dünne Faden gegenwärtig, in beiden lagen die Darmanhänge dem Nabel gegenüber.

*) Beyträge zur vergl. und menſchl. Anat. H. 1. S. 81.
**) Ebend. S. 92.

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NEUNTER BAND.

MIT FÜNF KUPFERTAFELN.

HALLE
IN DER CURTSCHEN BUCHHANDLUNG
1809.

Mein Vater *) fand ſie einmal mit Haſenſcharte, Gaumenſpalte und doppelter Gebärmutter, und ſahe mit denſelben Miſsbildungen in einem andern Falle zwar kein Divertikel des Darmanhangs, aber doch eine andere abweichende Bildung, welche deutlich daſſelbe ausdrückte, nemlich die vasa omphalomeſenterica, die von der obern Gekröspulsader ſich zum Nabel erſtreckten **).

*) Thesm de genitalium fer. ſeq. variet. Halae 1799. p. 27.
**) Ebend. S. 29.

51A. Meckel's description of the diverticulum called after him, and title page of the number of *Archiv fur die Physiologie* in which it appeared. Translation:

Diverticuli of the Gastrointestinal Tract.

"We might reject these reasons and examples as not proving the case of normal structures, since they describe monsters. Yet this objection is easily overcome by the study of human embryos. Recently I described a fetus (Studies in Comparative and Human Anatomy, 11:81) exhibiting a yellowish vessel differing from the umbilical vessels arising from the angle of junction between the upper and lower portions of the

Meckel the younger who wrote repeatedly and voluminously upon this subject and who devoted many years of study to this anatomical abnormality, hence to whom this eponymic honor chiefly belongs.

This remarkable family of Prussian anatomists included not only father, son, and grandson, but the younger Meckel had also a brother (August Albrecht Meckel, 1790–1829) who became professor of anatomy and forensic medicine at Bern in 1821.

The hobby of the Meckels was a magnificent anatomical museum which was founded by the grandfather, enriched by the father, and enlarged and maintained by the grandson.

Johann Freidrich the younger spent all of his vacations in scientific trips to the principal cities of Europe gathering materials for the museum:

To Italy in 1806, returning by foot all the distance from Florence to Halle.

To Naples in 1811, accompanied by his brother.

To Netherlands, England, and France in 1818.

To Vienna in 1819.

To Paris and Cette in 1821.

To Sicily and Italy in 1824; to Salzburg in 1828; to Venice and Trieste in 1831.

Meckel married in 1810 and his wife was his constant companion in his travels and studies.

When his father (Philipp) who was a highly honored obstetrician as well as an anatomist, was called to the Russian court at St. Petersburg to deliver Empress Marie, the younger Meckel accompanied him.

Meckel died at the age of 52 (1833) from "abdominal hydropsy," having suffered for years from an affection of the liver.

Biographie universalle; ancienne moderne, 27: 459.

Martins. Just a biography of J. F. Meckel. *J. d. conn. med. et prat.*, 36: 310–312, 1835.

Garrison, F. H. History of Medicine. Ed. 4, Phila., Saunders, 1929, p. 334.

Stedman, T. L. A Practical Medical Dictionary. Ed. 7, N. Y., Wood, 1922.

Buck, A. H. Reference Handbook of Medical Science. N. Y., Wood, 1923, 6: 284.

Bunts, F. Meckel's Diverticulum. Read before the Ohio State Med. Assoc., May 19, 1904. Pp. 537–555. (Pamphlet.)

Kemper, W. H. The World's Anatomists. Phila., Blakiston, 1905.

Continued from p. 129

small intestine and continuing into the umbilical sheath. In another still younger fetus I found a similar vessel continuing from the umbilical vesicle throughout the length of the umbilical cord. With this in mind I recently studied a few more embryos and found in older, about ten weeks old, embryos that the intestinal canal had returned to the abdomen and the above long canal as well as the umbilical vesicle had disappeared; but in another I found two embryos of this age (ten weeks) at the usual spot, about one inch above the junction of the colon with the ileum, beside the true appendix a real blind diverticulum, in one fetus it was half a line, in the other one line long; in the first it was placed perpendicularly, in the second, obliquely to the ileum and was only half as wide as the latter. In both embryos the omphalomesenteric vessels were present as fine filaments and in both these diverticuli were found right opposite the unbilicus.

My father found it [diverticulum] associated in one case with hare-lip, cleft palate, and duplex uterus; and found these same abnormalities associated in another case, not with a diverticulum of the intestinal appendage, yet with another malformation which distinctly represented the same abnormality; the vas omphalo-mesenterica which extended from the upper mesenteric artery to the umbilicus."

MANUAL

OF

DESCRIPTIVE

AND

PATHOLOGICAL ANATOMY,

BY

J. F. MECKEL,

Professor of Anatomy at Halle, &c. &c. &c.

TRANSLATED FROM THE GERMAN INTO FRENCH,
WITH ADDITIONS AND NOTES,

BY

A. J. L. JOURDAN,

Member of the Royal Academy of Medicine at Paris, &c. &c. &c.

AND

G. BRESCHET,

Adjunct Professor of Anatomy at the School of Medicine, &c. &c. &c.

TRANSLATED FROM THE FRENCH,

WITH NOTES,

BY A. S. DOANE, A.M., M.D.

AND OTHERS.

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IN TWO VOLUMES.

VOL. II.

LONDON:
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1838.

B. DIFFERENCES DEPENDING ON DEVELOPMENT.

§ 2185. Of all the parts in the abdominal cavity the intestinal canal is formed first; its mode of development and the changes in its situation, form, and volume, present equally remarkable phenomena.*

A. MODE OF DEVELOPMENT.

§ 2186. In respect to the mode of development one part is most intimately connected with the formation of the whole fœtus, but particularly with that of the intestinal canal, and must consequently be mentioned first: we mean the *umbilical vesicle* (*vesicula intestinalis*, s. *umbilicalis*). It is a small, more or less rounded pouch, situated between the chorion and the amnion, and is probably much larger in proportion to the fœtus the more recent the period of conception. It is even greater than the fœtus during the early periods of gestation, and we have reason to think that it is always formed before it. It extends first to the anterior face of the body of the fœtus, which rests directly upon it. But gradually and even early in the first month of gestation, it diminishes much, and is situated farther from the

fœtus, so that in the second month it is on the outside of the umbilical cord.

Do the parietes of the umbilical vesicle and the intestinal canal primitively communicate? Several anatomists of great merit † think that this communication is demonstrated neither in the fœtuses of the mammalia generally nor in that of man in particular. The following facts, however, render this opinion very probable:

1st. The analogy with birds, reptiles, and cartilaginous fishes, to the vitelline membrane of which the umbilical vesicle corresponds perfectly,‡ and in which it is proved that the communication in dispute exists at all periods of fœtal existence.

2nd. We sometimes perceive in very young fœtuses a canal which goes across the umbilical sheath, from the vesicle to the abdomen, and by which we can at pleasure empty the vesicle of this fluid, and fill it again.§

3rd. We always find in the fœtus, until the commencement of the fourth month, blood vessels which go from the mesentery to the umbilical vesicle, unite first on this latter, but gradually extend only to the anterior wall of the abdomen, and finally die, and are ruptured or entirely effaced. These are the *omphalo-mesenteric* vessels (*vasa omphalo-mesaraica*), comprehending an artery and a vein, which arise from the mesenteric vessels.‖

These vessels also exist in birds, where they go to the yolk, proceeding along the vitelline canal.

4th. The intestines are at first very near the umbilical vesicle, and are situated out of the abdomen in the umbilical sheath, which at this period really makes part of the abdominal cavity.¶

It is not unfrequent, proportionally speaking, to find in the full grown fœtus a canal which extends from the intestine to the umbilicus, which opens in this latter place, and is always attended by the omphalo-mesenteric vessels.**

It is then very probable, though not certain, from all these facts, that the umbilical vesicle and the intestinal canal originally communicate. There are, however, others which really demonstrate the existence of this communication.

Thus we have mentioned above a human fœtus five lines long, in which we saw distinctly a filament attached to the umbilical vesicle and extended to the intestine, and we have figured this communication as it exists in fœtuses of sheep and cows, since admitted by Bojanus also in the fœtuses of sheep.

* Emmert.—Hoerschstetter.—Cuvier, *Ann. du Muséum*, vol. III.

† Needham, *De form. fœtu*, London, 1667, p. 79.—Blumenbach, *Spec. phys. comp. inter anim. calc. mag. ov. et nov.*, Gottingen, 1780, p. 11.—Sœmmerring, in Haller, *Grundriss der Physiologie*, vol. V., p. 750, 800.

‡ Hunter, *Anatomische Beschreibung des schwang. Uterus*, p. 66.

§ Meckel, *Handbuch der pathologischen Anatomie*, vol. I., p. 862.—We have since verified this remark in at least ten fœtuses of this sort.

‖ Meckel, *Abhandlungen*, 1806, p. 301.—Oken, *Beytrage*, 1st d. ch. IV.

¶ We have collected, in the first volume of our *Hand. der Path. Anatomie*, all the known cases of this anomaly, one of which we observed and described (Meil, *Archiv. für die Physiologie*, vol. IX).

** 2187. Does the intestinal canal always communicate with the umbilical vesicle in one determinate point? What is this point?

First, this canal is continuous with the vesicle by its anterior edge, but very probably the point to which the communication is finally confined, always corresponds to a determinate place, although it may vary in a certain extent.

This place is in the small intestine, and nearer its lower than its upper extremity.

Very probably, there is a period in the existence of the human fœtus, when a similar small tubercle exists regularly, after the umbilical vesicle is separated from the intestine. Having found a very large diverticulum attended by the omphalo-mesenteric vessels in four human fœtuses three months old, which we had occasion to examine at nearly the same time, we have reason to think that the appendix continues regularly until this period, that is, long after the intestinal canal has entered the abdomen.‡ But we now renounce this opinion, although it has been refuted by no one. If a diverticulum really exist for some time as a normal formation, it disappears long before the end of the third month of gestation, since we have seen the cœcum in the seventh week, although there was no trace of a diverticulum; whence it follows, that the omphalo-mesenteric vessels continue much longer than it. But this circumstance does not prove that the diverticulum never exists normally, or that Oken's opinion of the cœcum is correct.

FIG. 51B. Title page and excerpts from English translation of Meckel's book.

EPONYM

SIR CHRISTOPHER ADDISON

Eponym: Addison's point. (Midepigastric point.)
Addison's line. (Transpyloric plane.)

Nativity: Hogsthorp, Lincolnshire, England.

Birth: Born, June 19, 1869. Living anatomist.

Source of Eponym: "On the Topographical Anatomy of the Abdominal Viscera in Man." *J. Anat. & Physiol.*, 33 (N. S., 13): 567, 1899.

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CHARLES GRIFFIN AND COMPANY, LD.
EXETER STREET, STRAND.
1899.

Journal of Anatomy and Physiology, July 1899. [illegible]

PLATE. ADDISON ON ABDOMINAL VISCERA IN MAN.

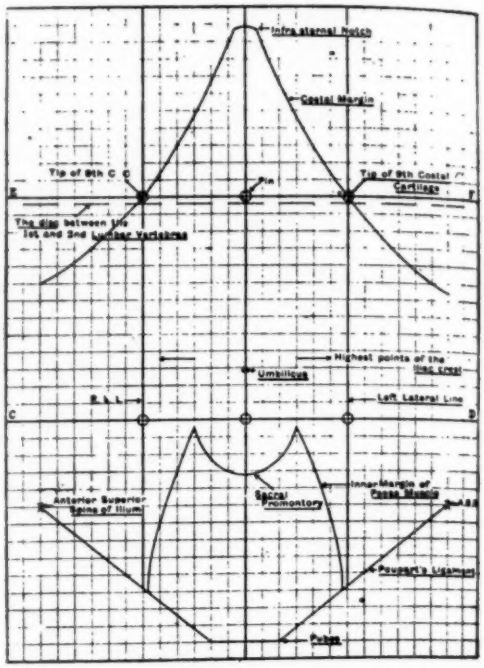

FIG. 1.—Diagram showing the average position of the landmarks whereby the abdominal regions are limited.

FIG. 52A.

ON THE TOPOGRAPHICAL ANATOMY OF ABDOMINAL VISCERA IN MAN, ESPECIALLY THE GASTRO-INTESTINAL CANAL.[1] PART I.

By CHRISTOPHER ADDISON, M.D., B.S. (Lond.), F.R.C.S., *Professor of Anatomy, University College, Sheffield.* (PLATES XLIII.–XLIV.)

PURPOSE OF INQUIRY.

With the advance of medical and surgical science, especially with regard to the operations of surgery on the abdomen, the topography of the abdominal viscera becomes of increasing importance.

The method of determining the position of the underlying parts should be as simple as possible, it should be convenient of application, and, withal, having regard to the varying conditions of the abdominal organs, as accurate as can be. One seldom meets with an abdomen which can be called normal in all respects.

The distance from the pubes to the supra-sternal notch is measured by drawing the tape tightly between these points. If the abdomen is convex, the half-way point is marked directly; if concave, the spot directly beneath the mid-point of the tape is taken; and at this point, after a small skin incision, a long steel pin is driven through the abdomen. This marks the level of the upper transverse abdominal line (E.F.).

[1] Read before the Royal Society, December 8, 1898. Communicated by Professor Alexander Macalister, F.R.S.

The average length of the abdominal part of the trunk was 35·8 cm., leaving the manubrium and body of the sternum a total average length of 16·2 cm., or 9·8 per cent. of the total height of the individual. Wright (9) gives the average for males as 9·65 per cent., and for females 9·22 per cent.

The average distance between the transverse lines was 13 cm., or a little over 5 inches. The average distance of the infra-sternal notch[1] above E.F. was 9·8 cm., nearly 4 inches, thus leaving a not too large interval between the body of the sternum and the upper transverse abdominal line. The maximum in this distance was 11·5 cm., and occurred only in 2 cases, and there were only 2 cases in which the distance was less than 8 cm.:—these cases being 7·25 cm. and 7·75 cm. respectively. In such a diversity of subjects, with so different characters of the chest and abdomen, this variation is small.

The line E.F.—Since the mid-point of the distance from the pubes to the supra-sternal notch is taken quite regardless of the condition of the body whether fat or thin, with the abdomen or chest distended or not, the regularity of the position found to be occupied by the line E.F. renders it a most useful line for surface marking.

My purpose, however, in selecting the transverse lines I have described, was simply the obtaining of easily-found, equidistant points for the purpose of measurement; and I was not prepared for the regularity of position in regard to the vertebræ and other structures which, especially, the upper transverse line E.E. has been found to possess. It corresponds almost accurately to the disc between the 1st and 2nd lumbar vertebræ, and cuts the junction of the 8th and 9th costal cartilages at the tip of the 9th.

[1] By the infra-sternal notch is meant the notch at the lower border of the sternum between the two 7th costal cartilages, as it can be felt and located on the surface. By the anterior superior iliac spine is meant that spot where the crest of the ilium, as felt through the skin, ceases, and where Poupart's ligament begins. The xiphoid cartilage is in all cases neglected.

FIG. 52B.

FIG. 52A and B. Title page of *The Journal of Anatomy and Physiology* containing Addison's description and excerpts from it.

QUESTIONNAIRE

1. What is the general shape of the abdominal cavity?
2. In what diameter is the abdominal cavity most narrow?
3. What is the narrowest point in the anteroposterior diameter of the abdomen?
4. Is the abdominal aorta normally palpable? If so, where?
5. What is the significance of palpation of the abdominal aorta in the epigastric region?
6. What information may the clinician gain when he is able to palpate the abdominal aorta?
7. With what may the palpable abdominal aorta be confused? How may proper differentiations be made?
8. What is the most important matter to determine clinically in regard to abdominal wounds?
9. Explain how intra-abdominal structures may be severely injured without evidences of gross injury to the abdominal wall itself?
10. State, in general, the methods of treatment of injuries to the abdominal wall itself.
11. State what may be done for the patient with a penetrating wound of the abdomen while he awaits operation.
12. Should all cases of perforated wounds of the abdominal wall be operated upon? If so, why? If not, when should expectant treatment be employed?
13. What percentage of gunshot wounds of the abdomen perforate abdominal organs? How many perforate intestinal tract?
14. What are the chief causes of death following perforation of abdominal viscera?
15. What percentage of patients with perforated wounds of the abdomen recover without operative interference?
16. What percentage of cases of gunshot wounds of the abdomen recover following operation? In civil practice? In war practice?
17. What factor, more than any other, influences the mortality rate with perforated abdominal wounds treated by operation?
18. Give the importance of the time factor in operations for abdominal perforations (statistical results in general).
19. Name some of the chief signs and symptoms caused by rupture or perforation of a loop of small bowel.
20. Explain how the following symptoms and signs originate after perforation of bowel: pallor, shoulder pain, hiccough, absence of liver dulness, shifting dulness in the flank, leucocytosis, dyspnea, shock.
21. What is the typical leucocytic curve following a subserous hemorrhage?
22. What are the chief signs and symptoms produced by free fluid in the peritoneal cavity? By free gas?
23. Name some of the evidence leading to a diagnosis of rupture of the bladder.
24. What intra-abdominal conditions are most often suspected after simple strains of the abdominal muscles?
25. In what types of patients are simple muscle strains of the abdominal walls to be especially looked for?
26. What is a desmoid tumor?
27. Give some important points concerning desmoid tumors.
28. How may intra-abdominal tumors and tumors of the abdominal walls be differentiated?
29. What is meant by the "line of congenital anomalies?"
30. Why are congenital abnormalities so frequently found in the midline of the body?
31. Why do congenital anomalies require particular care for their surgical cure?

SUPPLEMENT: A. J. S., n. s. Vol. VIII, No. 3, p. 738

32. Name ten or more congenital defects which may be found in the midline of the body.
33. What is an epigastric hernia? Varieties of epigastric hernias?
34. What are the symptoms produced by an epigastric hernia?
35. What disease may be most closely simulated by an epigastric hernia?
36. What is the meaning and derivation of the following words: umbilicus, navel, omphalos?
37. Explain the spontaneous cures of umbilical hernias which so often occur during infancy.
38. What are the ligaments of the umbilicus?
39. Explain the central depression of the umbilicus.
40. State some of the reasons why the umbilicus is of special importance to the surgeon.
41. What is pylephlebitis?
42. What is the caput Medusae? Explain mechanism of its production.
43. What is the origin of the term caput Medusae?
44. What are the nerves found in the umbilical region?
45. What lymph glands are present near the umbilicus?
46. What is the drainage of periumbilical lymphatics?
47. Has the umbilicus a muscle layer? Name the tissues found at the umbilicus.
48. Name the arteries and veins of the umbilical region; from where are the former derived? To where do the latter drain?
49. What is the urachus? The allantois?
50. What is a patent urachus? Its symptoms? Frequency?
51. What is the round ligament of the liver? Its origin?
52. When may the surgeon find it of advantage to severe the round ligament of the liver?
53. What vessels pass through the umbilicus during fetal life?
54. What vestigeal band passes at times from the superior mesenteric artery to the umbilicus?
55. What is a Meckel's diverticulum? Its normal incidence?
56. What is the origin of Meckel's diverticulum?
57. Give another name for Meckel's diverticulum.
58. What intra-abdominal pathological conditions are caused by persistent diverticuli?
59. What is the final site of embryonic closure of the anterior body wall?
60. When is herniation of the bowel through the umbilicus a normal condition?
61. What special precaution must be taken in opening the sac of an umbilical hernia?
62. How may small umbilical hernias most easily be detected?
63. What special preoperative precaution is important in dealing with huge umbilical hernias?
64. What is the chief difficulty during operation for large umbilical hernias? What special factor contributes to the high postoperative mortality of this condition?
65. What is meant by topography? Origin of word?
66. What are some of the difficulties encountered in creating a satisfactory system of topographical markings?
67. Name and bound the chief abdominal topographical areas.
68. Give the complete boundaries of the hypochondrium.
69. Name some of the transverse topographical planes used in reference to the abdomen.
70. What abdominal landmarks (external walls) are fixed and constant and which are movable or inconstant?
71. What is Addison's line? The midepigastric plane? The transpyloric plane?
72. With what intra-abdominal structures is Addison's line associated?

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73. What vertebra does Addison's line overlie?
74. Name some of the chief abdominal topographical points.
75. Where is McBurney's point? Its significance?
76. Where is Robson's point? Its significance?
77. Where is the point of greatest tenderness with acute diseases of the gall bladder? Why does this point vary with different individuals? How does it vary? How localized?
78. Bound Hesselback's triangle, Petit's triangle, Scarpa's triangle. What is the chief surgical significance of each?
79. What is meant by triangles of cutaneous hyperesthesia? Do they correspond accurately with Head zones or the distribution of peripheral nerves? If not what is their significance and value?
80. What is meant by a "flexible system of topography?"
81. Give examples of the use of such a flexible method.
82. What normal intra-abdominal structures may most frequently be palpated through the anterior abdominal wall?
83. What intra-abdominal masses are most frequent in each of the abdominal topographical zones?
84. What is the most common cause of the pains referred to each of the abdominal topographical zones?

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